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Chilean Nitrate Reserves Adequate for Generations

U. S. Government report emphasizes immensity of tonnage of prime material available for manufacture of fertilizer and explosives

Louisiana's Famous Monroe Gas Field

A phenomenal producer but not inexhaustible

By H. A. Wheeler

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Cost of United Comstock Mill

Current Prices of Materials and Supplies

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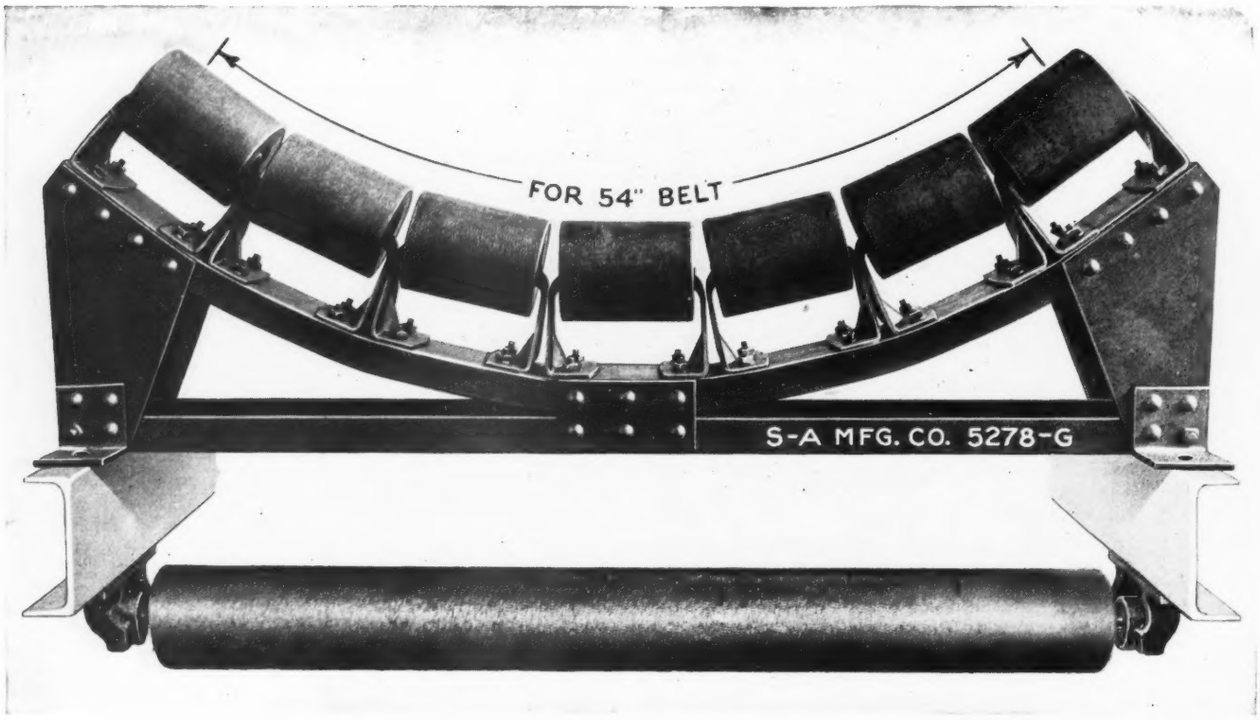
Useful Operating Ideas

From Field and Office

Biography of William C. Potter



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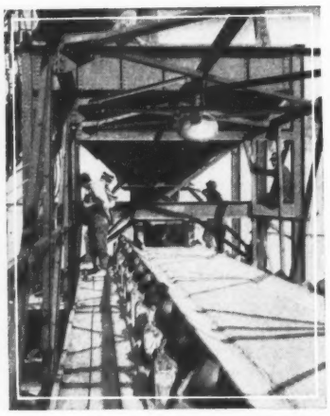

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

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Collapse of the Copper Export Association

WITH THE SURPLUS STOCKS held by the Copper Export Association exhausted, some of the members have decided that the disadvantages of handling their foreign business through the association are greater than the advantages and that it will be preferable for them to have an unrestricted outlet abroad. They are therefore resigning. This decision has been forecast by numerous rumblings of a break in the membership of the Copper Export Association that have been current for months, and like a good many of the rumors that are vehemently denied only to reappear constantly for further denials, this one has survived. The laconic announcement of the association that the Kennecott interests, American Smelting & Refining Co., and the Phelps Dodge Corporation had withdrawn from it tells the story in short sad words. Defection of these influential companies naturally weakens the power of the Copper Export Association abroad. Not that any foreign consumer will shed a tear over the event. On the contrary, there will be much elation, for the C. E. A. has not been overly popular in Europe. This is only a natural reaction, for no buyer of any commodity likes to be faced with a united ring of sellers. It is interesting to note, however, that the Copper Export Association and similar American organizations have been patterned after the old German cartel and other European bodies that were originally devised to do the very thing for which the C. E. A. was established. It is the old story of whose ox is being gored.

The main difficulty in the working of the C. E. A. has been to give the custom smelters the latitude they needed without being unfair to other members of the association. The custom smelters base their selling policy upon the principle that the intake of metals in ores should approximately equal the outgo as finished products. Any other policy than this one of balancing would require—willy nilly—speculation on the part of the custom smelters. Membership in an export association immediately hampers the custom smelters in the disposition of their metal production, because an unknown portion of it comes under the control of the export association. The custom smelter often finds itself in such a position that it must sell a certain tonnage of metal, in which event it would prefer to sell in the best market available, Europe or the United States. While a member of the C. E. A., it must confine its selling activities to the domestic market.

The C. E. A. has solved this problem in the easiest manner—letting those companies resign that feel it to their best interests to do so. In point of copper production controlled the C. E. A. has lost more metal than remains. Kennecott, Braden, Phelps Dodge, A. S. & R., Utah, Nevada Consolidated, and some smaller corporations will now sell independently abroad. A few strong companies will carry on: Anaconda, Inspiration, Chile, United Verde, Calumet & Hecla, Copper Range, United Verde Extension, Ray, Chino, and some others. The sum and substance of the whole change is that, whereas formerly the amount of copper sold abroad by independent companies was far in the minority, now it is in the majority. Competition for European business will be keener than ever.

There is a lesson in this for another great American industry—silver mining—in which an effort is being made to form an export association. How much more complicated is the problem of keeping intact a Silver Export Association? Custom smelters play an even greater rôle in silver mining and smelting than they do in copper smelting, which explains why the Silver Export Association has been so slow in forming and will now probably never be formed, for the organizers are well aware of the obstacles they must face—obstacles that have now disrupted the Copper Export Association.

Selling Precious Stones

LANGUAGE THAT SCINTILLATES in spite of minor errors characterizes a circular from Moscow announcing that the Russian Precious Stone State-Trust has been formed and is ready to furnish foreign buyers with emeralds, amethysts and other stones, as well as mineral specimens and fancy articles of lapis-lazuli, nephrite, rhodonite, jasper, and the like. Properties in the Ural, Altai and Saian mountains, bordering Asia, are controlled by the "Trust," it states, as well as manufacturing plants at Peterhov, Kolhivan, and Ekaterinburg. Mines in Turkestan yielding pale-grayish nephrites slightly tinged with green, vivid-green jadeite, carmine spinels in the Badagshan, and deep blue lazulite from the borders of Afghanistan are talked of. One property is in the Altai territory, where there are "quarries of porphyry and jasper, beautiful classical porphyry dear to ancient Greece, and that Ridder jasper, so gaily tinted, which reminds one of cotton-printed stuff, and the Revnev variety so quaintly streaked and lined, as well as pale-pink Tigueretsky quartz, not unlike the finest specimens of Uruguay, and lastly the unrivaled Beloretsky quartz, delicately veined and slightly tinted with pink and gray."

Nor is this all. The richest spoil comes from the Ural, it says, "especially that rare dark green malachite, or rhodonite, semi-transparent and sometimes cobweb-veined or tinted cherry-like . . . expanses of jasper . . . sparkling aventurine in quantities, to say nothing of variegated precious marbles." Then again, "golden green chrysolites, worn by eastern princes on their state robes and sabres . . . bluish topazes and the rare amethysts that glow fiery red in the evening light ready to be picked, alongside of pale yellow beryl, and cherry-hued tourmalines . . . red-green alexandrite and blue emerald mixed with yellow-green."

Enough of this sunset, a surfeit for the time! Send us a carload of them, little brothers—the price will make no difference.

Mills for Petroleum Geologists

IN THE EAST recently there has been considerable feeling concerning so-called schools which turned out doctors and dentists with a diploma, after a very short course of instruction. The lure to the client of these schools, of course, was the easy money to be earned as a doctor or a dentist. But these doctors and dentists have been branded as quacks, and the schools are threatened with the reprisal of the law.

Does not the same thing hold for other professions? It holds for the legal profession: does it not hold for the engineering profession? Should not the self-styled M. E. be prosecuted?

A correspondent inquired from us concerning the Ransomerian School of Geology in Kansas City. We made some inquiries and have its literature. Here is a petroleum geologist's mill. Its lurid prospectus is headed "Oil Geology—the Millionaire Profession." The prospectus offers the Ransomerian school as a "route to world's greatest profession—Petroleum Geology and Engineering." "We invite you to join this school with the firm belief that your efforts will be rewarded; your ambitions realized and that your fondest hopes of financial prestige and personal accomplishments will become a reality." "As an expert geologist you are not only able to command a professional fee of $50 to $100 per day, but you are constantly in touch with propositions that your geological knowledge enables you to turn into fabulous sums." You can learn the art either by day or by night. Presumably, if you study in the night school, you will be able to practice your "profession" only after sundown. "The average time required to complete the course and receive the degree varies, according to the ability and aptitude of the student. The average time in day school being five to ten months and in night school ten to eighteen months." The above quotation indicates the unlikelihood of the president of the school being strong in English. "In Oil Geology you learn that oil and gas is chiefly discovered in anticlines, synclines, monoclines and domes in the general geology you learn how these various structures were formed." A photograph of the diploma, with seal and all, is shown: it bestows the "Degree of Petroleum Geologist and Engineer." The prospectus says "Every student receives a beautiful diploma upon graduation." "We believe that any ambitious man possessing initiative and ability can, as an independent geologist, earn from $10,000 to $25,000 a year." All this for the complete sum of $300, plus $20 for books.

The whole plan is certainly vulgar and unethical; and its prospectus is misleading and lurid.

The United Verde Crushing Plant

A RECENT INSTALLATION of coarse crushing equipment at the United Verde smelter at Clarkdale, Ariz., affords another example of the variety in design and arrangement needed to meet specific requirements. As in other large tonnage plants, labor required for operation is reduced to a minimum. It is estimated that forty men will be needed for handling 4,000 tons crushed to 0.25 in. size. This is at the rate of 100 tons per man per day. Practically the only manual labor in the plant will be that required at the rock breakers. All others will be engaged in machinery adjustments and to insure proper attention at feeders, crushers, screens, and conveyors.

Automatic safeguarding from tramp iron by the use of magnetic appliances has been provided. This removes a prevalent cause of stoppage and breakage. All heavy machines are solidly foundationed, thus securing maintenance of alignment and maximum efficiency. Belting and shafting have been reduced to a minimum by the use of individual drives and speed reducers where applicable. Where shafting and belting are required, these have been isolated in such a way as to secure maximum safety to operators. Minimum repair and maintenance of motors have been secured by the general use of push-button controls. This factor also assures greater safety for the operators.

Provision for the removal of dust, which is not a mechanical feature noted in many dry-crushing plants, has been assured for this plant. Lighting has not been neglected, as the window area in the different buildings has a high ratio to wall area.

The installation is practically fireproof, wood except for a few conveyor runways and floors, being conspicuous by its absence. Thus the designers have secured hygenic conditions, a maximum of operating safety and fireproofness, as well as efficient and economical use of power. The whole plant will be described in an early issue.

Chilean Nitrate Industry Enters New Era of Development

ELSEWHERE IN THIS ISSUE—on pages 45-51—we print an abstract, of particular interest to our readers, of a government report by Dr. H. Foster Bain, Director of the U. S. Bureau of Mines, and Mr. H. S. Mulliken, assistant, on the price of Chilean nitrates. The significant feature in this is the agreement with the view, expressed more than once in contemporary technical journals, that the reserves of caliche in Chile are such that exhaustion need not be feared for several generations. We are glad that this point is settled once and for all, and we hope that those of the opposite opinion will cease the dissemination of statements to the contrary, which, in the past, have led to endless confusion and misunderstanding on problems of vast national and international importance.

In addition to removing any doubt as to the extent of the deposits, the authors of the report have concurred in agreement on another important contention given publicity in recent years—that existing methods of beneficiation are wasteful and inefficient; they make the statement that an additional extraction of 25 per cent of nitrate, from the same material, may be expected as soon as proved modifications are adopted on an extensive scale. Larger treatment plants are forecast; and attention is directed to the fact that Chile will doubtless readjust the export taxes so as to bear less unfairly on nitrate than they do at present. Profits from nine British companies in the nitrate year 1920-21 totaled $6,500,000, from an aggregate capitalization of $17,000,000. The pioneers, naturally, have the cream of the deposits; but the prospect of improving the technology of the pampa is so bright that other companies, owning lower-grade deposits than do the pioneers, may be confidently expected to earn profits that will be approximately equal to those obtained by the older companies.

The technology of treatment is essentially a chemical engineering problem, and this phase of the subject was

dealt with in detail in the January 7 issue of our contemporary, *Chemical & Metallurgical Engineering*. Only two new methods of treating caliche are discussed in the report—the Allen process and the Guggenheim process. The first, according to the report, is in successful operation at Oficina Delaware; the second has not yet passed the experimental stage. Both of these processes are offshoots of the mining industry, as it were; and a brief statement as to the development of each will be of interest to readers of the *Journal-Press*.

The Allen process was devised by A. W. Allen, now assistant editor of the *Journal-Press*. Its underlying principles were recognized after an extensive connection with the development of cyanidation. An early investigation in Chile of the work being done there for the recovery of nitrate from caliche suggested that at least one of the most successful early applications of the MacArthur-Forrest process could be modified for the treatment of caliche—the bulk leaching of fairly coarsely crushed material, afterward adopted for the extraction of soluble copper by hydrometallurgical methods.

An extensive experience in the handling of oxidized gold ores had shown that a considerable percentage of slime could be included in a mass and leached efficiently, provided certain principles were observed; but it was not until 1918 that extensive tests could be made on a wide variety of material on the Chilean nitrate pampa, which indicated the possibilities of a hot leaching process along novel lines. Other modifications were then introduced, and a method of treatment was outlined that differed from the Shanks process then and now in use throughout Chile in that it involved (1) finer crushing, to ½ in. or thereabouts; (2) efficient mixing and blending of the various caliches available; (3) even distribution of the charge in the vat; (4) provision of an adequate though sufficiently permeable support for the charge; (5) the exterior heating of solutions and (6) their upward displacement in the initial and secondary stages of extraction.

Tests and full-scale operations with various types of caliche have shown that an intelligent combination of these essentials will permit leaching to be carried to a logical conclusion, comparable to the results being obtained in the cyanide and oxide-copper processes. An important feature of the method was seen in the regular subsidence of the mass as extraction proceeded, the constant exposure of fresh surfaces and the gradual disintegration of the caliche serving to insure a high extraction of nitrate. Effluent solutions, taken from the surface of the charge, were free from slime; and that bugbear of the pampa, the borra problem, was proved to have been due to inefficient methods of treatment and the robbing of the natural deposit of good leaching caliche, to permit a fair recovery of nitrate by Shanks-maquina methods.

Results, after more than a year of operation subsequent to the remodeling of an entire maquina, have been such as to warrant the statement by the authors of the report that the Allen process "marks what is perhaps the greatest improvement reduced to practice in nitrate recovery in years." Results of its commercial adoption on a normal mixture of caliches from an average deposit may be expected to approximate the results of experimental work in showing a considerable improvement over the figure of 90 per cent extraction mentioned in the report as possible of attainment by this process, which is 25 per cent more than the average estimated as practicable by the Shanks process.

Business reasons are given for the scanty information available as to the technology of the Guggenheim method of treatment, which, however, may be said to involve cold or near-cold leaching and the refrigeration of the solution for the recovery of the nitrate. Unlike the Allen process, it cannot be applied in a small as well as a large scale, presumably because of first cost of plant. Earlier experiments showed what was well known to previous investigators in this field—that cold leaching resulted in an aggravation of the slime problem. This involved complicated and lengthy research, in connection with which the authors of the government report speak in eulogistic terms of the persistence and ability of E. A. Cappelen Smith, C. L. Burdick, and a staff of fifteen or so scientific and operating experts, whose previous achievements and records in the hydrometallurgy of copper are mentioned to justify anticipated success as an outcome of the research now being done, and to account for the conclusion that, in the opinion of the government investigators, the process "offers the largest promise in sight for making a satisfactory recovery from caliche of widely varying characteristics, and in particular from the borriente or slime-making varieties that are so troublesome."

The disadvantages of cold leaching are claimed to have been overcome by the adaptation of a chemical principle, known as the balancing of ions, whereby the disintegration of the caliche is prevented during leaching. As to the scale on which the Guggenheim process is best adapted, we infer from the frequent reference to Chuquicamata practice that exceptionally large vats are in contemplation, each of which will hold 10,000 tons or thereabouts; it would seem a bold move to adopt a unit of such a size in the nitrate industry, where the caliche is in thin beds, scattered over immense areas of ground. On the other hand, the report gives the cost of a new plant to treat 3,000 tons per day, presumably by the Guggenheim process, as $4,320,000; and between 3,000 tons per day and a 10,000-ton unit there seems to be no logical connection.

It is pertinent to remark that, in dealing with the Allen process, reference is made in the report to a book on the subject published in 1921. But in this the mention of large-scale operations was meant to be interpreted in a comparative sense—as indicating the desirability of using a unit several times the size of the one standard in nitrate oficinas today, which holds about ninety tons. The larger units adopted in the cyanide process were in mind; and, although there is no intention to minimize the logic in the statement in the report that the Allen process "has the further advantage [over the cold process] that it is applicable to existing plants, which can be adapted to it without complete rebuilding," it may be added that it was originally evolved with the idea that units of a size would be used in which the present costly and inefficient method of charging and discharging could be replaced by the adoption of mechanical appliances.

The problems involved in the mining and treatment of caliche are of intense interest. The industry is entering a new stage of development, and it is impossible to forecast the technical improvements that will result from the successful application of efficient leaching practice in the next few years.

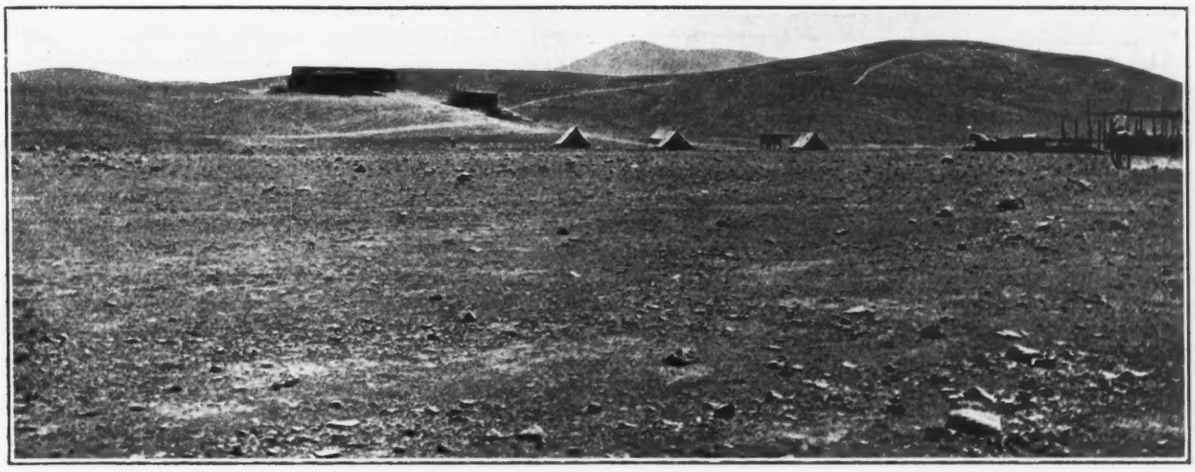
Mining Engineers of Note

WILLIAM C. POTTER

ASSAYING is the specialty of William C. Potter. At it he excels. It is the one thing than which he does nothing better. If he does not take pride in his attainments in this particular art he is more modest than most men. He weighs accurately and rapidly. He has an uncanny faculty for selecting the fluxes and reagents that will eliminate the dross most effectively and isolate the valuable elements in such form that they can be weighed precisely and evaluated accurately. And yet so far as we know he has never squeezed a burette nor weighed a button since he was graduated with the degree of Bachelor of Science in Mining Engineering from M. I. T. in 1897. We doubt whether a single one of the 5,000 men in the organization that Mr. Potter now heads is familiar with even such simple processes as bucking a sample, or feathering a cupel, or running a "slop" copper. Without involving ourselves further in this paradox, we explain: Mr. Potter is an assayer of business proposals and of industrial enterprizes. These are his ores; the camouflage, the side issues, the unsound premises are the gangue; and the essential facts on which a decision can be based are the metals that are to be determined. As president of the Guaranty Trust Co. of New York, Mr. Potter is responsible for a great many such assays, and big things hinge on the correctness of the analyses. Another miner-like characteristic of Mr. Potter's is his proneness to dig—to dig deep. Surface indications are not habitually to be ignored, but when a proposition is put up to him he likes to dig to the bottom; if there is any ore he likes to block out the shoots pretty thoroughly before he makes a conclusive report. If he has any failing, according to one of his close associates, it is that he is too conservative. However that may be, we are assured that if William C. Potter expresses a deliberate opinion as to the financial soundness of any undertaking a large part of financial New York is inclined to feel that further investigation is a waste of effort. That the greater part of his business activities have been devoted to mining is shown in the following outline of Mr. Potter's career. He was born in Chicago on July 16, 1874; he is of English extraction, his paternal ancestors having immigrated to Massachusetts in 1636. A couple of summers spent on his father's ranch in Idaho aroused a desire to live in the West; that is why he studied mining engineering. His first job was as engineer for the Liberty Bell Gold Mining Co., at Telluride, Colo. He spent two years as mining engineer in the Industrial Department of the Santa Fe R.R. As a member of the firm of Dickman, McKenzie & Potter he managed properties at Descubridora, Durango, Mexico, and in 1903 he became general manager in Mexico for the Guggenheim Exploration Co. From 1905 to 1911 he served as manager of the Southern Department for the A. S. & R. Co., with headquarters at Aguascalientes. After an interlude of four years as a vice-president of the Guaranty Trust Co., he returned to mining in 1916 as a member of the firm of Guggenheim Brothers. He was president of Kennecott Copper Corporation and vice-president of the Chile Copper Co. Since Jan. 5, 1923, he has been with the Guaranty company, first as chairman of the board of directors and then as president. During 1918 Mr. Potter, as Chief of the Equipment Division of the Singal Corps of the U. S. Army, did excellent work in organizing this important unit for efficient service.

WILLIAM C. POTTER

The theory is often advanced that mining engineering is excellent training for any kind of business career. It is argued that the successful business man should be trained to base his conclusions on clearly established facts and reach them by accurate reasoning. This is what engineering students are taught to do and what mining engineers must do. Mr. Potter's career seems to support the theory, although we are inclined to believe that, equipped with his natural qualifications, he would have gotten just as far if he had started as a bank clerk instead of going to M. I. T. and following the devious path that began 12,000 ft. above sea level at the Liberty Bell mine. We are glad he didn't, for, if he had, we should not have the opportunity of telling what a success he is making of his present job of assaying.



The camp of an untouched deposit in Chile, containing about 30,000,000 tons of workable caliche

Chilean Nitrate Reserves Adequate for Several Generations

Recent Report of United States Government Investigators Describes Mining Practice and Is Optimistic Regarding Future of the Industry

NITRATE was found in Chile, in the region where it is now produced, in 1809; and since 1825, when a trifle over 1,000 tons is reported to have been produced, there has been a recorded output up to the end of June, 1923, of 65,200,000 tons. The world's consumption has been increasing rapidly but irregularly. The rate of increase from 1830, in which year the output was 9,000 tons, was such that up to 1900 the output approximately doubled every ten years. From 1900 to the beginning of the World War, in 1914, the increase was less, amounting to a doubling in about fifteen years.

Since 1914 the conditions have been so disturbed that no safe inferences as to rate of growth can be drawn. The most remarkable and possibly significant feature has been the increase in demand within the United States, which absorbs nearly double the amount of pre-war years. Coincidently, the German market, formerly the largest open to nitrate producers, has disappeared. How much of this is due to temporary and how much to deep-seated causes it is unsafe to attempt to say. In general, the records show that the world's demand for Chilean nitrate has been increasing at a high rate and that, unless influences growing out of the war or which became effective during the war period have permanently altered the situation, still heavier drafts must be made upon the supply available in Chile.

As is true of other minerals, Chilean nitrate is exhaustible. The amount in the ground is not being increased, or at any rate there is no evidence of a measurable increase. The caliche beds represent the heritage of the ages, and drafts upon them are to be thought of as are drafts upon a savings-bank account.

Abstract from report on the cost of Chilean nitrate, by H. Foster Bain, director, U. S. Bureau of Mines, and H. S. Mulliken, assistant. A survey, the basis for the complete report to be issued by the Department of Commerce, was the outcome of Congressional order, as part of a general investigation into the nitrate industries, under the direction of Harry A. Curtis.

In view of the vital importance of nitrate to agriculture and to industry, more than usual attention has been directed at attempts to estimate the remaining reserves. It may be stated at once that no data exist for making an accurate inventory. No complete geological survey has ever been made, and it is not even certain that the origin and association of the caliche is well enough known to permit sound discrimination of probable nitrate-bearing lands from those that topographically or in other features resemble them. W. L. Whitehead[1] has pointed out reasons for thinking that there are significant geological features which would permit much closer estimating. Current statements as to the extent of unexplored nitrate grounds rest upon scattered and uncertain data mainly as to the presence at the surface of nitrate or the accompanying salts. These occurrences are frequently widely separated; and, in view of the extremely patchy distribution of the workable areas, it is not wise to attach too much significance to them. It has already been pointed out that of the government lands put up for sale to the end of 1900, only 12½ per cent was considered after test pitting to contain workable caliche, and evidence has also been cited to the effect that the workable areas are, in places at least, less extensive than inference from test-pit examination leads one to expect. These general uncertainties must be kept in mind in making any attempt to evaluate nitrate reserves. Nevertheless, it may be stated at once that the evidence, even though it be somewhat intangible, of the Chilean nitrate reserves being adequate to the world's needs for many years, is overwhelming. Of the various estimates that have been made from time to time it will be sufficient to quote a few only.

Francisco J. Castillo, inspector general of nitrate

[1] *Economic Geology*, Vol. XV, pp. 187-224, 1920.

deposits, reported in 1923 an estimate summarized as below:

1. The zone of nitrate-bearing grounds comprises about 200,000 square kilometers, of which so far only 5,811 square kilometers have been examined by excavations and test holes. The last-named area is owned partly by various companies and firms, and partly remains in the hands of the Chilean Government.

2. The examined area was calculated to contain about 290,300,000 metric tons of sodium nitrate; of which, up to that time, 45,000,000 tons had been extracted and exported. The remainder, at the rate of production then existing, was equivalent to a further 100 years' supply.

3. The unexplored area is about 34 times larger than the examined grounds; and, assuming that the former contains only as much recoverable nitrate of soda as the latter, a further 100 years' supply is thus obtainable.

4. In the examined grounds no raw material containing less than 11 per cent of sodium nitrate has been taken into consideration, nor grounds where the thickness of the layer of the raw material was less than 1 ft., except in the case of raw material containing at least 25 per cent of sodium nitrate, when the thickness of 8 in. and above has been included. The superficial area of each portion of ground examined has been divided by the total number of test holes made, in order to arrive at the area applicable to each test hole, and this consequently determines the total nitrate-bearing area. From the theoretical quantity of pure sodium nitrate resulting from the above operations, a reduction of 40 per cent has been made in order to provide for losses in extraction, manufacture, and errors of calculation.

5. Of raw material of a lower grade, vast quantities remain, which have been excluded from these calculations because they could not then be profitably extracted under the existing system of work; but a part at least of this low-grade material will doubtless be worked when the richer material is exhausted.

Bertrand quotes the following estimate made in 1915 as being the best summary available.[2]

Reserves of Caliche in Chile

Category	Metric Tons	Percentage of Nitrate Contained
1	9,200,000	45 to 38
2	18,400,000	38 to 32
3	32,200,000	32 to 25
4	55,200,000	25 to 18
5	82,800,000	18 to 10
6	138,000,000	10 to 8

As these figures refer to 1915, the aggregate of those assigned to Categories 1 to 5 must suffer a reduction of nearly ten million tons, which has been extracted in the last three years, principally from Categories 3, 4 and 5, that is from caliches containing 30 to 14 per cent exploitable nitrate.

In the preceding classification, Categories 1 to 3 include nothing but natural caliches, the varieties of which have already been described. The sixth category (8 to 10 per cent nitrate) consists mostly of natural costras, largely composed of soluble salts, the predominating one being sodium chloride; this category includes also what is called tierras—that is, loose dirt left on the ground, proceeding from the disintegration of caliche when breaking it up and loading, with a large admixture of pulverized barren material; these tierras are naturally the more abundant in the regions where caliches are soft. There is a class of raw material which is distributed between the fifth and sixth categories, comprising the ripios and borras, the most recent ones containing usually less than 10 per cent nitrate; the old ripios, however, have as much as 25 per cent (large "acopios" of these are found in Oficina Argentina), and the heaped-up borras made compact by compression, as much as 15 and 17 per cent (Oficina Argentina). No attempt has been made to estimate the amounts of the tierras, borras, and ripios; however, there is no doubt their aggregate bears a contents of many thousand tons of workable nitrate.

Summing up these impressions received and informations collected in his recent travel through the Pampa, the author (Bertrand) remains confirmed in his opinion that the above figures as tabulated, especially that concerning the sixth category, may be considered as minima, and, until an actual survey and valuation are undertaken, may serve as a reasonably reliable basis for general previsions.

Crookes Prophecy Discredited

In 1898 Sir William Crookes startled the world with an estimate of reserves that indicated a life for the industry of but a few decades. His knowledge of the fields at the time was limited, and the experience of the quarter of a century that has elapsed since has shown clearly that the pessimistic forecast that he then made was unwarranted. Making all due allowance for the uncertainties that enter into the making of any estimate in this field, there is still no reason to doubt the presence of a large reserve, one fully adequate to answer any probable world demand for several generations.

In considering the future of any mineral industry it may be taken as basic that if the world needs the material, process of production will be improved and costs cut or prices increased sufficient to bring it out, however low the grade that remains; and in the nitrate fields, as in other mining regions, ability to work lower grades adds to the available reserve. Two antithetical processes are in operation. Mining is exhausting the beds, but improved technology is rendering lower-grade material available, thus increasing the reserve, and, by developing substitutes, passing over to other materials an increasing portion of the burden of meeting the world's demand. It seems fairly certain that long before the natural nitrate has been used up, satisfactory substitutes will be available in adequate quantity.

As a practical matter it is not necessary to enter into elaborate calculations as to whether there is enough nitrate available to supply the world for 200 or 300 years. Assuming an increase in production such as to double the output every ten years, which is the maximum long-time increase the industry has had to meet, at the end of twenty-five years the annual output would be about 16,000,000 tons. Any one familiar with the situation will have little doubt that if it prove impracticable at that time to meet such a demand it would be rather because of lack of water, of labor, of facilities for shipping or some similar necessity rather than of raw material. In the present state of flux of technical knowledge, the probable changes in process in the various nitrate industries will almost certainly become the determining factor rather than shortage of raw material. Without, therefore, attempting to make an independent estimate as to reserves—a long and costly investigation if the results are to be worth having—unqualified confidence can be expressed in the ability of the Chilean fields to meet all probable

[2] "The Chilean Nitrate Industry," Paris, 1920.

demands for a period much longer than it is possible to foresee the result of other more important factors.

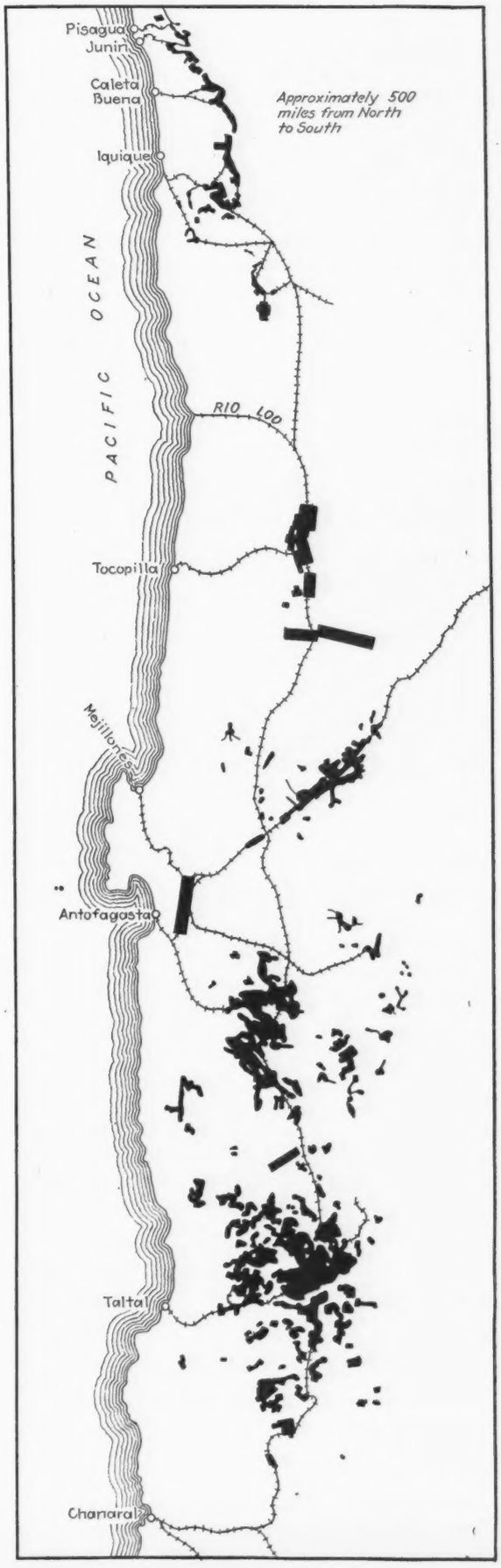
The nitrate lands available for further development are partly in private ownership and partly belong to the government. Existing private titles had their origin in grants made by the Peruvian and Bolivian governments prior to the taking over of the region by Chile. Lands belonging to the government are put up for auction from time to time after examination and with an estimate of the recoverable nitrate content. A price is set for each tract; but bidders may, and do, go above it in their bidding. The policy governing the opening of new lands in the past has been to offer land for sale at a rate proportional to exhaustion of the lands already in production plus a reasonable margin for increase of output. There has been no holding back to create an artificial scarcity, which in fact would be impossible anyway so long as private lands remain to be opened, nor has there been a forcing of lands on the market, which would have overstimulated the opening of new oficinas. Indications of a change in policy as to opening nitrate lands are shown in a bill that passed Congress this year. In it the sale of more than thirty tracts of land within the next two years is specifically authorized, and this sale is being urged as a means of raising 30,000,000 pesos of revenue needed to balance the budget as a result of the failure of Congress to pass a recommended income tax bill.

The title given by the government is that to all the nitrate in the ground, together with right of use to the surface. It is not to minerals in general, but only to those of the nitrate group, and the government could grant the same land, with proper restrictions, for copper or gold mining if the facts warrant. In practice this reservation is not important. The title given is not in fee simple; and in theory, at least, the lands will revert to public ownership when the nitrate has been mined. Actually, no lands have so reverted; and, in view of the absence of any requirement as to working them, the process of reversion is certain to be a slow one. The incentive to work and not to overbuy is that arising from the interest charge on the sum paid the government.

Mode of Occurrence and Mining Conditions

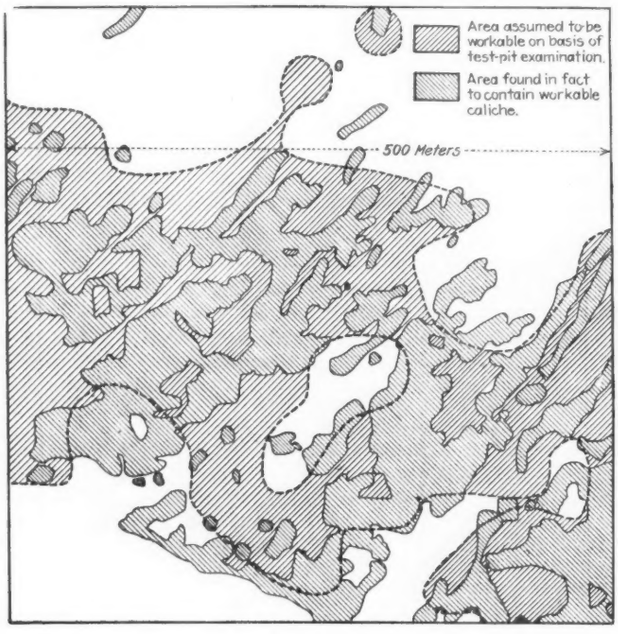
The nitrate of commerce is a crystalline salt derived by leaching and precipitation mainly from bedded sedimentary rocks and gravels found in northern Chile. To a minor extent nitrate also occurs as the cementing material in shattered igneous rocks and in little vein fillings. In the main the beds in which it occurs are terrestrial slope deposits corresponding in origin and character to the outwash gravels commonly found along the front of mountains facing plains. At the lower edge of the slopes the nitrate deposits in places spread out over or merge with salt deposits formed by evaporation in the shallow basins or "calars" of the undrained valleys. Essentially, the nitrate occurs as a cementing material in ordinary slope gravels and sands.

The nitrate country extends from 26 deg. south latitude, a short distance below the port of Taltal, to 19 deg., near the northern boundary of the country. The deposits occur on the upland or pampa lying between the coast range to the west and the lower slopes of the Andes to the east. The altitude varies from 4,000 to 9,000 ft., but the majority of the nitrate mines and works are at 4,000 to 7,500 ft. above sea level. The deposits are not continuous, but extend in an irregular



The nitrate region in Chile

belt from 5 to 40 miles wide, with barren intervals between. Within the limits of a particular deposit there is marked variation in thickness, depth, grade, and extent. The beds actually now worked vary in thickness from 8 in. to 14 ft.; the depth, from the surface to 25 ft.; in content, from 12 per cent, the present minimum, to as much as 40 per cent of sodium nitrate. The ordinary workings are by open pit or trench 6 ft. or less in depth and with 2 to 3 ft. of thickness of material containing 18 to 20 per cent of nitrate. The amount of nitrate to be won per acre varies greatly from tract to tract. Examination of numerous maps and properties leads to the generalization that only 40 to 50 per cent



Results of sampling and mining a deposit of caliche

of the area of land taken up for nitrate mining proves to be workable.

The amount of nitrate in the land is estimated for purposes of sale by a form of investigation known locally as a cateo. The area under consideration is laid out in square kilometers and the content estimated by sinking test pits down to and through the nitrate-bearing bed. Experienced prospectors can tell in advance of such examination a great deal about which areas are probably nitrate bearing, and in this way they limit the amount of land actually tested. Within the probable area it is usual to begin by sinking pits at intervals of 500 meters. When nitrate is found, intermediate pits are put down, with the general plan of having them at intervals of 100 meters over the nitrate-bearing ground. If puzzling irregularities are found, as is usually the case, pits are sunk still closer together, and the results of all the pits are, or at least should be, taken into account in estimating the content of the ground.

Sampling Methods Are Simple

The method of sampling the pits is crude and far from accurate, and there is reason to think that the method of combining and evaluating the results is also far from exact. Certainly they are much less so than are those used in examining tin or gold placer gravels, though the value of the nitrate in the ground is higher per cubic yard than in the case of either metal.

The method of sampling nitrate ground has been often described. Briefly, a small pit, big enough for a man to work in, is sunk through the loose ground at the surface which may be from one foot to four feet in depth. In the center of the pit a smaller hole, about the size of an ordinary post hole, is then sunk to some bed recognized as below the nitrate. This inner hole is sunk by means of a hand jump drill and black powder, small shots being put in as necessary to carry on the work. The final result is a roughly round hole 8 to 12 in. diameter and 3 to 6 ft. deep. From the sides of this hole a sample is channeled off by means of a long steel bar similar to an ordinary crowbar. The sample is caught as cut by an assistant, who has a round iron spoon fixed at right angles to a long wooden handle. From the sample accumulated in this manner there is picked out a number of chips supposed to represent the same material as would in mining be hand sorted out and sent to the treatment plant.

Actual Nitrate Recovery Seldom Tallies With Original Estimate

Much may be said in criticism of this method of sampling, but essentially it is an attempt to anticipate the result to be expected in actual mining, and that is what sampling is for. So long as the mining itself continues to be merely breaking up the ground—waste and nitrate rock together, and then hand sorting for a material to send to the crushers—the theory of the sampling is sound. In practice it leads to many disappointments. It is obviously largely dependent upon the personal judgment of the sampler. He determines what shall be rejected and what shall go into the sample and he is rarely the one who afterward operates the property and carries into practice the standard applied in making the examination. Personal judgment in such matters, too, is not a constant. A man will, to some extent, reject at one time what at another he accepts, and he has no adequate method of checking and steadying his judgment. Furthermore, the method of cutting the sample introduces an irregular variable in that the same amount is not obtained from each foot of thickness of the bed sampled, and in particular there is a systematic error in that the bottom of the whole is not as well sampled as at the top. All this is aside from the great and rapid variation in the thickness and grade of the material, which makes it possible for samples cut from opposite sides of the same canyon to vary in content from 5.17 to 21.5 as in one instance observed. Indeed, it happens that pits barren on one side show workable caliche on the other.

As a matter of fact, serious disappointments have arisen when attempts have been made to win from the ground the nitrate estimated on the basis of such examination as indicated above. Not all of these disappointments can be traced to intentional deceit or to careless work. Some are due to the inherent difficulties of the job and the inaccuracy of the method. Speaking in most general terms, it would probably be safe to say that ground as mined contains a larger tonnage of a lower-grade material than that usually estimated. Every allowance should be made for the low value of the material in the ground and for its irregular distribution, but it remains true that the methods of sampling are inadequate to obtain any accurate measure of the value of an individual piece of ground.

Certain rough generalizations have grown out of experience and are followed in the purchase and devel-

opment of properties. For example, in one field it has been found that a bed of nitrate containing 18 per cent, and being 8 in. thick under a cover of not more than 3 ft., is workable. In another case a bed 8 in. thick and of 33 to 40 per cent grade was being successfully mined under 25 ft. of cover. Such definite statements can, naturally, apply only to particular places. A more general statement is that if 1,000,000 Spanish quintals (about 50,000 short tons) of recoverable nitrate can be anticipated per square kilometer of area, there should be profit in mining the ground; but this is offset by statements that the actual yield is not more than one-half that indicated by cateo. The truth seems to be that no one knows just how accurate a cateo is, nor is a general rule possible, because the result is so largely a personal judgment. In one case the actual yield from a particular measured area was approximately 20 per cent of that anticipated. In another it was 55 per cent. These are probably low figures, but no sufficient data are available for a general statement.

The individual prospect pits are sunk by contract, and the direct cost is approximately 25c. gold per foot of depth. It is sufficiently accurate to assume a general average depth of 6 ft., so that the pits cost about $1.50 each. To this must be added the cost of surveying, camp maintenance, and engineer's fee. If the pits be spaced at 100-meter intervals, four-tenths of a hole would be required per acre of ground examined; and although the cost varies greatly with distance from water supply, extent and speed of the examination, and other factors, it may be taken as approximately $0.80 per acre.

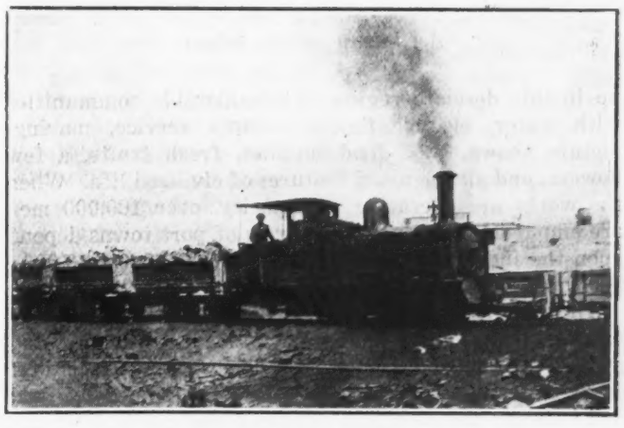
Not all, however, of the land dotted with test pits will prove to be nitrate bearing. The areas of workable ground are extremely irregular, and the patchy distribution of the nitrate is one of the fundamental factors influencing choice of working methods and costs of production. Study of a number of areas leads to the generalization that of the grounds considered by general study to be probably nitrate bearing and subjected to test pitting, approximately 40 per cent, by area, prove to contain nitrate rock of workable thickness and grade. The cost of examination needs therefore to be multiplied by 2½, in order to get the cost per acre of workable ground. To reduce this to cost per ton it is necessary to have the data or to make assumptions as to thickness and grade of each tract examined.

Many Unusual Features Noticeable in Acquiring Land

In curious variance with mining practice elsewhere, much nitrate ground is bought upon the seller's examination and appraisal. This applies especially to the fiscal lands. The Government of Chile maintains an engineering staff for examination of its lands. It has followed the general policy of offering for lease new acreage at about the estimated rate of exhaustion of the lands already being mined. Prior to such an offering, the government engineers make a cateo of each tract offered. It is made in the usual way, but detailed maps and record of the findings in each pit are prepared and made public. The maps show the exact location of each pit and the report gives the thickness of caliche, its percentage of nitrate content, the amount of cover, and other pertinent data. The engineers calculate from this the probable yield; and the ground is put up for auction with a minimum price based upon these calculations. Anyone who cares to bid is welcome, if he wishes, to resample the pits; but as a general rule bidders seem to be satisfied to check the printed data; and in practice nowadays the nearest neighboring company can ordinarily, having plant and facilities already available, make the best bid. The price paid is an amount per ton based on the estimated yield as determined by the government engineers, not revised to correspond to actual yield as the ground is worked. Recently, in a few cases, the government has permitted private companies to examine fiscal lands and make offers based upon their own examination, subject presumably to check by the government staff so far as it may be considered necessary.

The sum paid for nitrate lands bought from the government is calculated in Chilean gold or sterling exchange. The money is paid in three installments; one-third down, one-third in six months, and one-third in twelve months. Being a lump sum, it is properly a capital charge subject to amortization as such. It is ordinarily taken as 3d. per Spanish quintal of recoverable nitrate estimated to be in the ground. Aside from fiscal lands, there are in the nitrate fields large acreages that are privately owned. These rest on concession titles from the Bolivian and Peruvian governments and antedate the Chilean régime. Sale of such lands is an ordinary matter of bargaining; but, with the big reserve in the hands of the government, the price of fiscal lands necessarily determines the market except in the case of special locations or advantages.

Title to nitrate lands in Chile is of the nature of an indeterminate lease until exhaustion of the property, with a fixed lump sum as advance royalty paid once for all. During the period of occupation, possession is complete, save for the usual reservation of public rights of way, subject to discovery on the ground of certain other minerals such as copper and gold. As a practical matter in the nitrate fields, the latter reservation is unimportant; and actually the nitrate producer, although he has only bought the nitrate and not the land, has exclusive possession of the latter so long as any nitrate remains to be worked. There are no requirements as to steady working; the one holding title can, and does, exclude from the property any one he cares to for any reason. The latter right has become important to the operators in combating the efforts of the unions to organize the workmen.

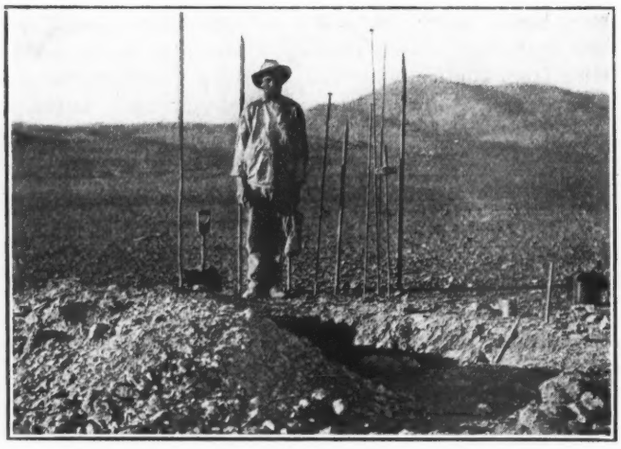


Bringing caliche to the plant

The patchy distribution of the material, the marked and rapid change in its thickness and assay value, and an equal degree of changeability in the thickness and

character of the overburden are fundamental factors that must be taken into account in any plan of development. The overburden varies from loose sand to rock so hard that it must be drilled and blasted to be broken; and, when it has been removed, the upper surface of the nitrate is as irregular as the wave-marked surface of a sea under a fairly stiff breeze. The country is arid. Fresh water must be piped many miles from the high mountains, and only in part of the region can salt water be obtained from wells at feasible depths. There is no vegetation save in limited areas. Only one river crosses the pampa. Workmen, food supplies, fuel, and all materials other than rock, sand, and gravel must be brought from long distances. Hot sunshine and cold fogs are the portion of most of the pampa. Occasional torrential rains occur in all parts, and to the south at the higher levels light snows fall in winter. Heavy frosts extend far to the north, and a thin layer of ice forms over exposed surfaces of water in July.

The world's demand for nitrate has led to the building



A Chilean caliche miner

up in this desolate region of considerable communities with water, electric lights, railway service, moving-picture shows, good food supplies, fresh fruits, a few flowers, and all the usual features of civilized life. When the works are operating at capacity, over 100,000 men are employed directly, and a series of port towns depend upon the industry, whose product is 2,500,000 to 3,000,000 tons of nitrate per year.

The fact that the nitrate is found in thin irregular patches at or near the surface leads naturally and properly to open-cut mining. The further fact that there is usually a difference easily recognized by field test between the rock that does and that which does not contain nitrate points, too, to hand sorting as one stage in the process of preparation. Formerly a sharp distinction was observed between caliche—a very rich material consisting essentially of crystallized nitrate and other salts—and costra—a lower-grade rock or gravel impregnated with nitrate. With improvement in methods of handling and process of treatment, resulting in sending material to the plant of lower and lower grade, this distinction is in process of abandonment; and it is common now to find the term caliche applied to all the material sent to the crushers.

Where the area of any patch is sufficiently extensive and the grade of caliche is consistently high enough to permit regular working, the ground is opened by trenches. These are carried forward laterally across the ground to be mined, the caliche and overburden being drilled and blasted ahead of the trench, broken and hand sorted in it, the waste rock piled back of the trench with the caliche on top, and finally hauled from there to the crushers along temporary narrow-gage railway lines connecting with main field lines ramifying over the property. When the patches are too small or the grade is too irregular, the material is won by the older style of mining, which involves working small pits from which the nitrate is collected by carts. Formerly all the drilling and blasting was done entirely by hand, and carts were used to bring all the nitrate to the main field lines. Now, at many properties, air drills have been introduced for breaking up the big blocks, and efforts are being made to use them in the first breaking of the ground as well. At present the latter work is still accomplished by putting down with hand jump drills and small pop shots, a hole 6 to 8 in. diameter, chambering it below the nitrate bed, and blasting with 300 lb. or so of a cheap slow-burning black powder made locally. The effect of such a shot is to heave up the ground in blocks of as much as 12 ft. diameter; consequently, the necessity for secondary blasting is evident. It is not the purpose of mining to break the rock fine, as this increases the loss. The large blocks are broken with 25-lb. sledges, and the caliche is separated from the barren rock by hand sorting in the pit.

This is a crude method of work, and hand sorting under such conditions is necessarily more expensive than from a belt properly placed in a mill, but it results in sending to the crusher only the material that is at least near to the predetermined grade. Actually it reduces the bulk of material handled by from 50 to 85 per cent. This is important, under the conditions now obtaining, from the fact not only that the cost of transport of excess material is avoided, but the process of treatment used is one adapted economically only to high-grade material. To send to the crushers the whole of the rock broken in the pit would enormously increase the cost of treatment and reduce the recovery.

Unfortunately, there is no known mechanical process for separating caliche from barren rock corresponding to wet concentration and flotation as used in treating the ores of metals. Hand sorting is necessary unless and until some method of treatment be devised which is very much cheaper than any yet found; and, so long as sorting must be done, the saving in transportation is probably more than the gain in efficiency and decrease in loss from using picking belts below the crushers, as is usually done elsewhere in mining.

Working Methods Are Suited to Labor Available

Fortunately the workmen available, Chileans and Bolivians, are good sorters, and the methods of mining developed in the field are peculiarly adapted to the temperament of the work people. They are, to an unusual degree, individualists, and work best when each has his own particular job or place of work, the miners, indeed, being known as particulares. The whole industry has been cleverly organized on the basis of piece work and stint, with minimum wages advanced from day to day and the opportunity for each workman to set his own pace and to make extra wages if he cares to do so. The sinking of test pits in prospecting, blasting ahead of the trenches, block holing, sorting and loading ore, and, in short, all the processes of mining, are paid for by the piece, and in each case the workman receives a cash advance for each day he works. In the treatment plant

and elsewhere the same principle is followed, though the exact basis is necessarily different. All this appeals keenly to the workman. Each miner has his own place, and the rate of pay per cartload of material delivered by him is fixed by the ratio of overburden to caliche, difficulty of sorting, and similar conditions. Two men commonly work together, but very rarely more than two; and frequently not even one partner is tolerated. Under these conditions the men break up as much as twelve tons per man per day, sorting out and piling for loading as much as three and a quarter tons of caliche, under conditions not unusually favorable. Underground, from a bed 6 to 10 in. thick, in rock that requires to be blasted, the men mine two-thirds of a ton per man per day, handling about eight tons of material to get one ton of caliche. Under these conditions, material is handled at the surface for less than 10c. gold per short ton labor cost, and underground for a trifle over 30c. The mere statement of these costs and conditions indicates sufficiently how small is the hope of decreasing costs by introducing machinery in the mining part of the work. So long as enough labor can be found to work according to the present methods, it will only be in exceptional places that money can be saved by introducing machinery.

Hand Sorting Proves Cheap

It has proved possible to increase the output per miner per day by more careful division of the work, introducing air drills for breaking boulders, releasing the miner from the requirement of piling his caliche symmetrically, and making other changes that a careful study of the situation indicated to be warranted. In a specific case an increase of 37 per cent in output per day from the same number of miners with the same amount of ground was brought about. The nitrate region is now short of labor, and in the years to come it seems likely that managers will need to adopt every possible means of increasing the output per man per day, even though no decrease in cost result. In other words, it is likely to be less a matter of lowering costs than of holding them at the present level as far as actual mining is concerned. At present, hand-sorted caliche is delivered on track at costs ranging from 30 to 50c. gold per ton; and, as already noted, from two to five tons is broken and handled for each ton loaded out. These costs compare most favorably with any others possible as a result of using steam shovels or other power mining machines; at the same time, the thinness of the beds is a factor unfavorable to such shovels, and the hardness and irregular thickness of much of the overburden operates against the use of scrapers.

It does not follow that there is no field for mechanical equipment in mining, but only that the general introduction of machine methods is not to be expected unless very much cheaper methods of treatment be found. In special cases, drag-line scrapers and steam shovels have already been introduced, but, so far as could be determined, no great advantage in cost had resulted. There was in some ways a better control of the work and fewer men were needed. Both of these factors are likely to be increasingly important in the future. The development of the smaller shovels and competing equipment for use underground elsewhere may well result in bringing to light something widely applicable to mining nitrate.

Transportation of the caliche to the treatment plant is by field railway lines of various gages. Carts are used but rarely, to gather caliche mined in small patches or from outlying parts of the property. There is a distinct trend away from carts and toward direct loading. There is a further tendency toward larger central treatment plants, drawing caliche from greater distances, and the use of heavier locomotives and rolling stock. Formerly haulage of one-half mile to one and one-half miles was the usual limit. Now caliche is hauled as much as 25 miles in heavy trains of fifteen-ton cars running on well-built main lines. When necessary, caliche is brought to the main lines over temporary 60 cm. tracks in seven-ton side-dump, horse-drawn cars. With this system the cost is about ⅜c. per ton a mile, and the success of the plan is dependent largely upon placing the treatment plant so that the grades favor the loaded cars. According to the extent to which this is possible and to which it is necessary still to use carts, the cost of transport varies usually from 10 to 25c. per ton. In practice it is rarely economical to use carts when the haul is more than 1,600 ft., or to build in a track for direct loading until at least 4,000 tons of caliche has been mined and piled for shipment. These figures necessarily vary greatly as to the cost of construction of field railway lines for heavy haulage. In pre-war years these came to $4,000 or $5,000 per mile.

Cost of the United Comstock Cyanide Plant

By Walter S. Palmer
Acting Director, Mackay School of Mines

AS A SUPPLEMENT to the article on "The New Treatment Plant of the United Comstock Mines," by George J. Young, in the *Engineering and Mining Journal-Press* for Nov. 11, 1922, the following data on the cost of the plant will prove of interest. This data were filed recently with the Nevada Tax Commission by Roy Hardy, formerly manager of the company. The figures constitute part of the public record of a hearing recently held before the commission in an endeavor to have the assessed valuation of the property reduced. Work was started on the mill July 1, 1921, and the plant was put in operation on Sept. 23, 1922. It was designed for a capacity of 2,000 tons per day.

Cost Data on United Comstock Mill

	Building	Equipment	Installation	Total
Warehouse	$12,845	$296	.....	$13,141
Plate shop	4,303	1,961	.....	6,264
Power plant	9,604	35,283	$10,694	55,582
Crushing plant	137,113	155,561	23,513	316,187
Conveyor plant	10,892	.....	9,202	20,746
Grinding plant	158,041	120,544	35,268	313,854
Cyanide plant	341,848	283,840	93,700	719,389
Filter plant	.....	73,837	12,621	86,967
Precipitation plant	.....	18,803	1,425	20,241
Refinery	23,983	9,327	2,017	35,329
Assay office	17,335	2,289	1,432	21,058
Concentrate plant	.....	17,931	7,966	25,898
Heating	.....	6,397	5,042	17,704
Machine shop	14,318	26,297	1,672	42,287
Carpenter shop	2,313	.....	.....	2,313
Water supply	.....	18,819	18,416	37,595
Car dump	.....	8,644	3,915	12,657
Totals	$732,558	$779,836	$226,890	$1,747,279

Building Construction Costs

Bunk house	$37,455
Mess hall	23,103
Staff houses	18,389
Hospital	11,757
Cottages	61,868
Store	8,049
General office	9,500
Total	$170,124
Grand total	$1,917,403

Louisiana's Famous Monroe Gas Field

Its Long Life Seems Assured, But Exhaustion Is Inevitable

By H. A. Wheeler
Mining Engineer, St. Louis, Mo.

IN NORTHEASTERN LOUISIANA is the largest and richest gas field thus far discovered in the United States. This is the Monroe field, which has a daily producing capacity of over 2,000,000,000 cu.ft., although not more than 10 per cent of the proven area has been developed. Huge as these figures are, they are based on actual gagings and are not the crude estimates at which most gas wells are rated, that almost invariably err in being decidedly too liberal. It is also unique in being carefully guarded and protected from the usual waste and abuse through the judicious guidance of an able State Conservation Department. Louisiana promptly recognized the enormous value of this prolific pool and has taken measures that greatly redound to the credit of its Conservation Department.

As usual in the northern Louisiana and southern Arkansas oil pools, the topography has no relation to the underground structure, and as reliable outcrops are lacking, the geologist is able to study the structure only from the record of the well logs.

The field was discovered by a small wildcatting company under Louis Lock in September, 1916, at Spyker, in the northern part of the pool, in searching for oil. It is exclusively a gas field, as to date no oil has been found, although drilling has been carried to 4,000 ft., or more than 1,500 ft. below the gas sand.

The proven territory has been largely absorbed by strong companies, which hold it partly in fee, but mainly under lease. The early leases were written on the usual basis of an annual flat royalty that was $200 per well, but these have since been replaced by leases that call for a one-eighth royalty for the gas (or the usual rate paid for oil). In the early days the fees could be purchased for $10 to $25 an acre, as the area is largely timber or inferior farm land, but today the prices range from $100 to $500 an acre.

The field is situated along the Ouachita River, in Ouachita, Morehouse, and Union parishes (counties), in a sparsely settled country where the only large town is Monroe, with about 15,000 inhabitants. Monroe is 7 miles south of the field. It is the business center, with two branches of the Missouri Pacific R.R. extending from it along each side of the field, and the L. A. & M. road passes through the central portion. Monroe is also on the V. S. & P. railroad, which runs direct to Shreveport, 95 miles away. Shreveport is a large center for oil-country supplies.

The gas field lies mainly along the low bottoms of the Ouachita River at an altitude of 65 to 90 ft. above tide, with gently rolling fringes that are 20 to 50 ft. higher.

Porous Limestone Carries the Gas

Gas occurs in the Annona chalk, a soft porous limestone that occurs at 2,100 to 2,500 ft., and most of the wells are 2,150 to 2,250 ft. deep. The porous horizon of the chalk, or "sand," rolls considerably and varies greatly in porosity, so the wells range from 200,000 to 43,000,000 cu.ft. and are drilled in the "sand" from 2 to 90 ft.—mostly from 30 to 50 ft. The gas has an abnormally high pressure, or 1,000 to 1,050 lb., and mainly consists of marsh gas or methane (CH_4) and has 960 B.t.u. or heat units. It is a "dry" gas and its gasoline contents range from 600 gal. in the southeastern part of the field to 100 to 125 gal. per 1,000,000 cu.ft. in the northwestern area.

The field runs north and parallel with the Ouachita River, which flows through the western side. As defined to date by drilling, the field is 26 miles long with a width ranging from 10 miles at the south end to 16 miles in the middle and 6 miles at the northern end. Dry holes seem to limit the eastern and southern boundaries definitely, but the western and northern limits may be more or less extended by future drilling. The developed area covers approximately 350 square miles, which makes it the largest individual gas pool in the United States.

The very large wells, or those gaging over 25,000,000 cu.ft., occur in four groups, of which three are on the eastern edge near Swartz, Collingston, and Wardville, and the fourth group is in the Guthrie district, in the middle of the pool. The Swartz district, on the southeastern edge, has been the richest and is the most heavily drilled, with two to three wells on forty acres in some places. The gas at Swartz has the highest gasoline content, or 400 to 600 gal. per 1,000 cu.ft., and is the largest carbon-black center in the district, having five plants in operation and three more under construction.

Rotary Method Used in Drilling

Drilling is done by the rotary system, and three strings of casing are used, the hole being finished with 6⅝ in. casing of 24-lb. weight. No water sands are met above the gas sand, except a thick sand at about 750 ft., that gives artesian flows of 300 to 600 gal. per minute of a sweet, slightly sulphurous water. Salt water has thus far been found only below the gas rock in wells drilled as deep as 4,000 ft. Drilling is done on contract on the turn-key system, or complete with the master-gate, for $15,000 to $18,000 per well. The pressure is reduced at the well to 200 to 300 lb. and the gas is conveyed by 4-in. lines to the carbon-black plants.

The State Conservation Department requires the casing strings to be set in cement (two weeks), and the maximum delivery from all wells is restricted to 20 per cent of the potential gaged capacity as determined by the state inspector. The state also requires that a permit be taken out before starting a well and the filing of a complete log of every well and daily pressure gages. If the gas contains over 150 gal. of gasoline per 1,000,000 cu.ft., the state requires the erection of an absorption plant to extract the gasoline before it can be used for carbon black. The Monroe office of the Conservation Department has a complete record of every well, which is accessible to the public and from which much of the following data are obtained.

Sixty-eight Per Cent of Wells Drilled Productive

Up to July, 1923, 221 wells had been drilled, of which 181 had been saved as producers, thirty-two or 15 per cent, were "dusters" or non-productive, fifteen blew out (cratered), and three were junked before reaching the gas sand. Of the thirty-two dusters, eight were inside

wells and the remainder were edge or outside wells that aid in defining the field. This 15 per cent is about the usual percentage of dry holes found in the majority of normal fields before the limits are defined.

Of the 181 producers, two gaged 43,000,000 cu.ft.; thirteen from 30,000,000 to 40,000,000 cu.ft.; twenty from 20,000,000 to 30,000,000 cu.ft.; forty-three from 10,000,000 to 20,000,000 cu.ft.; and 102 or 56 per cent gaged less than 10,000,000 ft.—down to 200,000 ft. The average of the entire field is about 11,000,000 cu.ft.

Of the producing wells, 70 per cent are being used and 30 per cent are shut in, either waiting for a market or having been drilled to comply with the requirements of the lease.

Up to Oct. 10, a total of 101 wells were drilled in 1923. These came in with a total capacity of 1,283,000,000 cu.ft. This is the greatest number that have yet been drilled in the ten and one-third months, and five of these were non-productive. The ninety-six producers averaged 13,700,000 cu.ft., as most of them were drilled in the richer portion of the field.

Much of Output Used in Making Carbon Black

The potential capacity of the Monroe field today exceeds 2,000,000,000 cu.ft., which is being steadily increased by drilling five to ten wells monthly. The principal market for this enormous output is found in the thirty-three carbon-black plants scattered throughout the field, whose daily requirements range from 5,000,000 to 60,000,000 cu.ft. per plant. Though most of these plants own their own wells, some buy on the open market at 3c. per 1,000 cu.ft. at the well.

Besides a few small towns, the only outside markets at present are Bastrop, a growing industrial center of about 4,000 people in the north end of the field, and the Monroe center, of about 18,000. At Monroe, the industries are furnished gas at 10 to 12c. and domestic service at 30c. per 1,000 cu.ft. A new 12-in. line is being completed to Alexandria (12,000 population), 102 miles distant, at a cost of $2,000,000, where domestic users will be supplied at 80c. and where the peak load may reach 8,000,000 cu.ft. per day.

The production of carbon black is a specialized industry that is confined to back-woods settlements and gas fields that are without an industrial outlet. It can thrive only on very large supplies of natural gas that is very cheap. Before the Monroe gas field was discovered, most of the plants were in the out-of-the-way districts in West Virginia that were not accessible to the Interstate gas lines. When the rich Monroe gas field was discovered, in 1916, one of the old West Virginia companies, the Columbian Carbon Co., promptly recognized the great value of this field for carbon black because of the great gas volume, the long distance from important industrial centers, and the occurrence of the gas on cheap land. The company at once secured over 16,000 acres in fee and leases and has been steadily building carbon-black plants since 1916. It now has eight plants of one to eleven units, a unit capacity having about 5,000 lb. daily output from 5,000,000 cu.ft. of gas. Other manufacturers have been attracted by the cheapness and enormous quantity of the gas, and today there are thirty-three plants in operation and seven more under construction.

When the gas contains over 150 gal. of gasoline per 1,000,000 cu.ft., the state requires the installation of an absorption plant to extract the gasoline before using gas for black. This recovers about 80 per cent of it.

As a carbon unit costs from $75,000 to $150,000, and a gasoline plant about $75,000, the state has been benefited by an investment of over $12,000,000 in plants and wells. The land owners have also secured several millions in bonuses and royalties from lands that probably averaged an assessed value of not over $10 an acre. Yet with this large investment, besides the employment of over 1,000 men in this new industry, the carbon-black business has been bitterly attacked as a wasteful consumer of the gas. At first it looks like a perverted application of the gas to burn it to secure a pound of black that mainly sells for 7 to 12c. a pound, although special grades bring 25 to 50c. But the domestic markets that are within a reasonable distance take less than 1 per cent of the present output. With the southern climate and the lighting field previously occupied by electricity, the domestic requirements are unusually light, with their short, moderate winters. With the heavy investment in pipe lines that are worthless when a field is exhausted, and with only five months out of the year when the demand is large, capital has not been attracted to convey it to the large domestic markets that are 100 to 300 miles distant. The public demands unreasonably low prices for natural gas, yet ungrudgingly pays $1 to $2 per 1,000 cu.ft. for artificial gas that has about half the heating value. If natural gas rates could be obtained in proportion to its heat value, that is, if domestic consumers would pay $2 to $3, as against 25 to 75c. that they usually expect, the radius of distribution would be greatly increased. So the tire trade, which takes most of the output, and the manufacturers of printer's ink are the principal beneficiaries of this big gas field; for the tire makers find that the mileage of a tire is nearly doubled when carbon black is substituted for zinc oxide as a filler in auto tires. There is no black pigment equal to natural gas carbon black for high-grade printer's ink. As about 15,000,000 people are interested in durable tires and more than 50,000,000 are interested in good printer's ink, especially in our daily papers, there are emphatically two sides to the so-called misapplication of natural gas for carbon black. Coal or wood are available everywhere for domestic heating, although far less desirable than natural gas, but as more than 40 per cent of the people want good durable tires and good news print they do not regard the use of the natural gas for this purpose as wasteful.

Long Life of Pool Predicted

The local idea prevails that the field is inexhaustible,[1] and some persons familiar with the district have estimated a life of over forty years. There is also a feeling that the field is being fed by faults from a larger or deeper reservoir and claim that this is borne out by a failure of the pressure to drop. This latter statement, if true, would be extremely important, but it is not based on sound premises. If the porosity of the chalk is 20 to 40 per cent, as claimed, and the field is only about 5 per cent drilled, the flow of gas from the undrilled areas to the tapped areas would give this false impression of no drop in pressure, except where locally heavily drilled. Now, the Swartz district is thus far the only area that has been heavily drawn on

[1]Since this article was written, salt water has made its appearance in several wells, especially in the Swartz district. The pressure is also showing a very marked shrinkage in the Swartz district, which is the most heavily drilled area in this field. These two facts will call for a heavy reduction in the early highly optimistic predictions that have been made by others as to the productivity of this unusually large gas field.

and this shows a decided drop in pressure—of at least 20 to 25 per cent. The theory of the so-called Monroe fault—if the fault exists—is probably based on the variable depths at which the porous horizon is found, similar to the Indiana Trenton limestone, which also shows quite a variation in the depth of the porous gas-bearing horizon. Numerous deep wells drilled below the gas—to as much as 1,500 ft.—have thus far failed to find deeper gas sands, so there is no satisfactory evidence that the pool is being fed from deeper sources and the apparent lack of pressure drop is merely due to the equalizing action of 40 ft. or more of an unusually porous "sand" that is of such enormous size that the extent to which it has been drawn upon thus far is slight in comparison with its unprecedented volume. Though unusually large wells have been found at Swartz, the "sand" has been so heavily drawn on to meet the excessive concentration of carbon black plants that the pressure has dropped to 750 lb. As some of these wells are within a mile of the eastern edge of the field, and there have been instances of over-drilling —two to three wells on forty acres and even line fights —the wells are drawing too rapidly on the reservoir for the gas to flow sufficiently rapidly through the rock to maintain the original rock pressure, so this district foretells the doom—exhaustion—that ultimately overtakes all gas and oil pools, or exhaustion. Of course, the larger the pool the slower the rate of exhaustion, and the enormous size of this pool has deceived the local enthusiasts. For although the pool is now seven years old, which is time enough for most gas pools to show a marked drop in pressure, it is only within the last two years that it has been considerably drawn on, and this drainage has been mainly confined to five districts.

When the present carbon-black plants under construction are completed, the probable demand on the field will approximate 400,000,000 cu.ft. daily, which is about 20 per cent of the present potential capacity.

Although it is quite probable that the field may be extended more or less to the north or west, from present known prospects the increase is not likely to exceed 10 or 15 per cent, which is far less than the recent growth in the demands. Another important matter that does not seem to be appreciated is the fact that the building up of the output has been confined mainly to the areas where large wells were obtained and this has established the high average yield of 11,000,000 cu.ft. per well. When the leaner areas, which greatly exceed the rich acreage, are drilled, the field average will materially recede and may drop to 5,000,000 cu.ft. per well.

Carbon-black Industry May Be Curtailed

As the carbon-black market is at present overloaded, the recent rapid increase in plants will probably greatly diminish, if not cease, and it is not impossible that the state may halt further expansion of this industry.

With so many undeterminable factors, it is dangerous to estimate the life of the field, and the above-noted factors are cited to show that the Monroe pool, like all gas fields, will ultimately be exhausted and much sooner than many of the local optimists believe. If there is no increase in the number of carbon-black plants now under consideration and operation, they may be able to secure their supply from this pool for about twenty years, more or less, which is an exceptionally long life for any gas pool. The discovery of deeper gas sands or a marked extension of the pool may increase the life of the plants materially, but it will certainly be reduced to less than twenty years if they continue to grow as they have grown for the last two years. When the field is finally unable to supply the carbon-black plants, there will probably be ample gas for a considerably longer period to furnish the present domestic markets.

Barranca del Cobre, Chihuahua, Mexico

Early Tin Mining in California

Reminiscences of the First Commercial Production of Block Tin in the United States

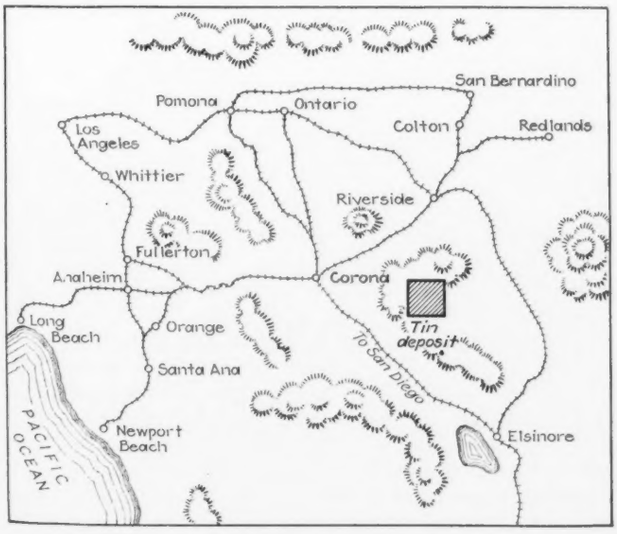
By H. E. West
Mining Engineer, Santa Barbara, California

RECORDS other than inscribed or written are quickly forgotten. Doubtless, to the present generation, tin mining in the United States is unknown, or at least forgotten. In America there are several sporadic occurrences of tin. The only real attempts at tin production in this country were at Harney Peak, in the Black Hills of North Dakota, and at the Temescal tin deposits in southern California.

After a visit to the Temescal deposit, now dismantled and abandoned, and its brief history locally all but forgotten, I concluded that it might be of interest to revive and preserve some of its records. I was then a young engineer, on my first job, having come from England to erect and operate a pneumatic stamp battery and tin-dressing plant.

"El Rancho Sobrante de San Jacinto," an old Spanish grant of 40,000 acres, contained the tin mines, the Gavilan gold mine, and a wide area, with prospective water supply, of future citrus orchards. This extensive tract, about seven miles square, bordered on the present town of Corona, then known as South Riverside. Its topography was broken—a country of steep hills and deep canyons, with areas of mesa land.

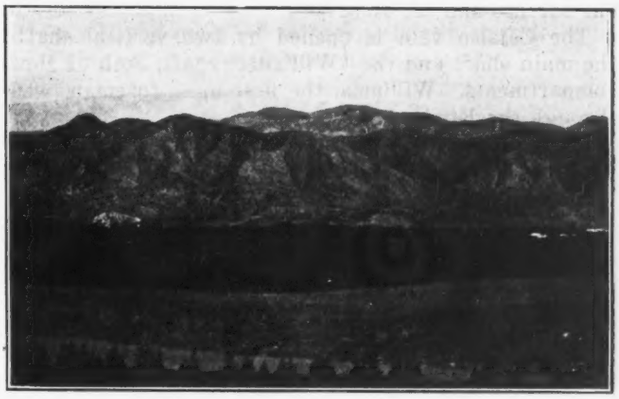
Its earliest workings are said to have resulted from a rush in the 70's, when a crowd of excited stakers settled in the canyon and contiguous hillsides. Little work seems to have been done, for when I arrived on the scene in December, 1889, there was the main adit, a well-timbered incline shaft down about 100 ft. and a well-preserved wooden horse whim.



Sketch map showing location of Temescal tin mine

In the spring of 1889 Col. Ned Robinson, of a well-known western mining family, introduced the property in London, where it was floated as the San Jacinto Tin Mines, Ltd., for £100,000 with £20,000 working capital. This company was later reorganized into the San Jacinto Estates, Ltd.

While visiting the Cornish tin mines Colonel Robinson became interested in Husband's pneumatic stamps, extensively used in crushing the hard tin capel. This stamp was originally brought from America by the inventor Sholl. It was improved by Harvey & Co., who patented it. The pneumatic stamp compressed its air, as it was rapidly raised by reciprocating cylinders which were belt driven. A sharp jerky blow resulted,



A view of the San Bernardino range, in which the Temescal deposit is located

most effective in crushing hard rock. Each head crushed sixteen tons of run of mine through a 30-mesh screen per twenty-four hours, taking 16 hp. Four heads of the six supplied were erected.

As in Cornwall, granite, or rather "greisen," is the wall rock of the tin lodes. Eruptive dikes, similar to the Cornish "elvan cross-courses" are persistent. Igneous rocks, both deep-seated and extrusive, compose the entire area. The western area consists of porphyritic rocks, and acid glassy extrusives. Slate, shale, or the "killas" of Cornwall is conspicuously absent. In Cornwall "killas," or slate, is never far from productive tin lodes, and the lodes occur in the slate, or in the granite near the contact with slate.

There are exposed seventy-two distinct lodes, coursing through the granite, mostly parallel, or at least in groups paralleling each other. The strike varies from east to west and north to south.

The Cojalco vein alone was proved to be tin bearing. The Cojalco hill itself is a mass, or "blow," of black lode rock, and its upstanding jagged outcrop is a prominent feature. The Cojalco vein strikes about southeast, dipping to the west at 70 deg.

Cojalco hill, as prospected by an adit and 50-ft. crosscut, although showing a strong lode, is barren. Strangely enough, outside of this one vein, during many months of prospecting, sampling the more important surface showings, bruising and washing the samples on a vanning shovel, none showed the familiar edge of tin.

In the Santa Ana mountains, in a line with the con-

tinuation of these lodes, Surveyor Ensign, who made the survey of the mountains, informed me of tin deposits, and there was talk of stream tin. "Tin Mine Canyon" still shows on the map.

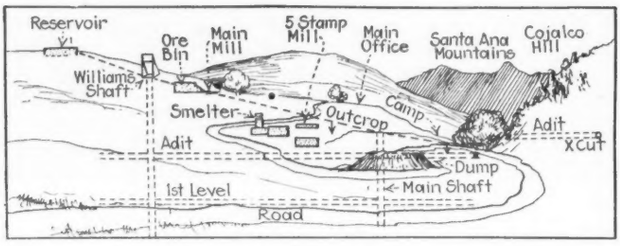
Speaking of vanning shovels, we had gold pans, Mexican horns, and other paraphernalia, but the genuine tin miner invariably used the wide vanning shovel, imported from Cornwall. The shovel has much to recommend it, once its peculiarities are mastered. For instance, the sample can be burnt in the fire, to drive off impurities. To a novice, however, the pan is safer.

Vertical Shafts to Reach Deposits

There is no stream tin, disproving the theory of the denudation of any upper oreshoots. This absence of tin in the outcrop of these remarkably strong and numerous lodes is its most disappointing feature, especially so as the shoots of the Cojalco vein are near the surface and are rich.

The Cojalco vein is opened by two vertical shafts, the main shaft and the "Williams" shaft, both of three compartments. Williams, the first mine foreman, went through the Kimberley mine fire.

The granite walls stand well, needing little timbering, just light sets and dividers. The lowest development is approximately at 300 ft. in the main shaft. Above the adit level—under water at my visit—the ore has been stoped and in one instance mined through to the surface. Below the adit all the known ore has undoubtedly been stoped.



A sketch made from the hanging wall side in July, 1923, showing the outward appearance of the mine

In 1891, when I left the mine, I have distinct remembrance of a wide black lode at the bottom of the main shaft, but destitute of tin. As Captain Harris used to say, "Black as the ace of spades, you, but nary no tin." In 1892, when the mine closed, the lode at the bottom of the Williams shaft had pinched to 3 in. On the dump today this lode material looks favorable for tin.

The mine never made much water, a 3-in. sinking pump taking care of that in the main shaft. Today, with the mine flooded, the issuing water is inconsiderable.

The occurrence of tin as cassiterite was singularly pure, being free of common impurities such as mispickle, the arsenical iron sulphide, and other elements, requiring elimination by "burning" or calcination before concentration. Black tourmaline is the prevalent accessory mineral, the ore being characteristically blue-black. Iron oxide, as hematite, occurs, and from its color is likely to be mistaken for cassiterite; until crushed on the shovel its red streak, in strong contrast with the milky streak of tin, proves its identity. Weight alone, therefore, cannot determine a sample.

Tin ore is heavy, and under ground is a ready means of approximating its value, just as in native silver ore, as at Cobalt. By scratching it with the fingers one can roughly estimate its silver content.

Garnet tin in a blue-black matrix is the usual occurrence of the Cojalco cassiterite, often lining small cavities or vugs with resplendent crystals. In "Toy's" stope above the adit the tin was fine and light in color—almost the "Daw" tin of Dolcoath.

Cojalco tin stone is characteristic and readily spotted from any tin ore that I have ever seen. Cojalco ore is today found in many a mineral cabinet.

In the early days, that is in 1890, the tin content was about 5 per cent Sn, as I remember that Edward Mathey, the metallurgist, informed me that no ore below that grade was mined at Cojalco. In Cornwall today 20 lb. of tin to the ton, or 1 per cent, is considered payable. This grade was by no means maintained in subsequent returns, and I doubt whether during the life of the mine over 2 per cent Sn was returned.

Output for Only a Short Period

The production is problematical. There are no available records. The mine was productive from the spring of 1890 to the spring of 1892.

A small five-stamp mill was the pioneer or test mill. In the middle of 1890 two heads of pneumatic stamps were operated, and later in the fall four heads, capable of reducing from fifty to sixty tons per twenty-four hours of run of mine through a 30-mesh screen.

As a personal estimate through the working life of the mine, approximately two years, I think that there may have been mined 12,000 tons of ore yielding 240 tons of 50 per cent black tin, giving through the smelter eighty tons of block tin. Tin was then selling at 25c. a pound. The gross return was $40,000.

The ore was dumped into the mill bin and passed through the pneumatic stamps, without preliminary reduction or automatic feeder, and crushed through 30-mesh round-hole punched copper screens, the water splash itself effectually feeding the mixed coarse and fine ore through the mortars. The mortars were square, with screens on three sides and one mortar to each head. Vanners were adopted as concentrators.

There was Woodbury with his ribbon rubber belt, and Brownell with the Frue vanner. The first 6-ft. Frue was designed for this ore and worked well. This is the first recorded instance when vanners were commercially used in tin concentration. Except at the edges of the belt the tailing was clean, but there was considerable tin escaping near the flange. Rittinger bumping tables were also used in experimental test work.

Years later, at the Dolcoath mine, in Cornwall, in 1898, when the Frue vanner was first adopted in Cornwall, Mills, the tin dresser, vanned a sample of the tailing, taking the sample from the middle of the belt, and passed the shovel to me. I selected my sample from the edge, and, as I expected, vanned a goodly edge of tin. Mills looked at me but said nothing.

In California, although a complete dressing plant was provided from Cornwall, it was never erected. Labor was prohibitive in cost. The concentrate or "black tin" was smelted at the mine. Here again another record was made, for at Cojalco black tin was first smelted by the use of crude petroleum.

Elsinore coal, a semi-lignite, was used for the generation of steam, later replaced by crude petroleum from the Puente oil fields. Petroleum was then beginning to be extensively used, and in Los Angeles the

manufacturing plants were adopting it for all purposes, such as heating forges and for boilers.

A small reverberatory furnace, about 6x9-ft., top fed and hand rabbled, was constructed, using oil and superheated steam through a special burner. The first furnace lost considerable metal through a defective floor. A second furnace was constructed with a layer of fireclay under the bottom bricks, and an arch under the furnace. This furnace gave every satisfaction and stands today, save for vandalism, as well as when constructed.

Local Metallurgical Practice

A charge of about one ton, using limestone and culm, or crushed anthracite, as a flux was reduced in about six hours. The slag was run off and the furnace tapped and the metal run into an outside separately heated kettle, and cast into bars. Before "poling" was introduced the product was impure, eliciting no very flattering remarks from the packers who used our tin as solder.

To review the proposed operations briefly: As planned by Colonel Robinson, and partly executed, a dam was to be constructed in the canyon, 3 miles west of the mine. Both power and water would thus be available for the reduction works. A mill of 100 tons per twenty-four hours was to be erected a mile below the dam. An adit was to be driven to the mine, 3 miles easterly, cutting the several loads en route, and giving one thousand feet of "backs" and liberating the water. The adit was to be continued southeasterly another 4 miles, thus crosscutting the seventy-two exposed tin lodes on the property.

Such a comprehensive plan, together with the development of the mine, its buildings and equipment, called for a working capital of nearer a million dollars than the original $100,000 supplied. Here, then, was the first and greatest fallacy, in not cutting the garment according to the cloth.

Next, with little or no attempt at mine development extensive and expensive surface development was undertaken and expensive camp buildings were built, with no ore developed or exposed. It seems strange that such a misguided policy should ever have received the sanction of the London board—if, indeed, it ever did.

The dam was partly erected and is still in place, though not resting on bedrock, for a drill subsequently disclosed about 30 ft. of boulders and wash below the wall. Expensive foundations were put in by the writer for the battery.

The Debacle

Then the money gave out. Colonel Robinson died in London in 1890. More capital was then subscribed in London, and Captain Harris, a Cornish miner, came out, after reporting favorably, to manage the mine. Apropos of the examination, the captain confided to me that after he had vanned the samples from the bottom of the shaft, in the taking of which he had ready assistance, surprised at the result, and suspicious, the crafty Cornishman descended alone at midnight and resampled the shaft. Three samples were barren. The Captain's former samples were "salted."

The entire canyon project was abandoned, and an earnest attempt was made to open and develop the Cojalco vein, on which two vertical shafts had been started, ignoring a perfectly good and well-timbered shaft sunk on the lode and well below the adit level.

The mill, first of two then of four heads, was erected at the mine between the shafts. Water was pumped from underground, and by clarifying and repumping proved adequate.

In 1890 the tariff was an important issue, and the question of duty on tin plate rested on local production. In that year President Harrison visited southern California, and his presidential train was stopped in the vicinity of the tin mines a sufficient time for the President to be impressed by the sample of tin displayed and the oratorical magnitude of the undertaking in the neighboring hills.

At Harney Peak, in the Black Hills, North Dakota, this same year, an extensive low-grade tin deposit was being exploited. Captain Josiah Thomas, manager of Dolcoath mine, in Cornwall, was commissioned to report. His report was unfavorable and the mine closed.

In 1891, Gervaise Purcell, of Los Angeles, representing some of the leading interests, was appointed general manager, and under his management operations were conducted until the mine was finally shut down in the spring of 1902 for lack of funds.

Thus ended a costly attempt to produce tin in California!

I was young in those days under review, yet familiar with tin and tin mining, having lived amid the Cornish mines. Since then, in common with most mining men, the world has been our stage, and a hard-bought experience has been gained of many metals; yet, after thirty years in revisiting these old-time tin deposits, examining the showings there exposed, and remembering the many prospects seen and sampled in earlier days, it seems incomprehensible that one lode alone of all the number exposed should contain tin, or that the small upper stopes, rich as they undoubtedly were, comprised all that a bountiful Californian nature provided. Such, indeed, was a freak occurrence. California is generous both at surface and underground, and in many instances one metal replaces another, as, for instance, copper lodes making tin at depth. The Cojalco vein is a clear case of "not disproven"—the evidence is not sufficient to condemn. Some day these tin deposits may again be worked, and perhaps not unprofitably. Their history affords a striking lesson of how not to do things.

Fort Collins Gasser Under Control After Two Weeks

The great gasser opened up in the Fort Collins field by the Union Oil Co., after almost two weeks of uninterrupted flow of approximately 80,000,000 cu.ft. of gas every twenty-four hours, was brought under control. The company announced that it would at once start two new wells, one on the Wellington structure near the gasser and the other on the Fort Collins structure, several miles to the south.

Hundreds of leases have been signed up in the three counties adjoining, most of which are termed "short time," providing that drilling shall begin within six months, and it is conservatively estimated that at least fifty rigs will be under construction before the first of the month.

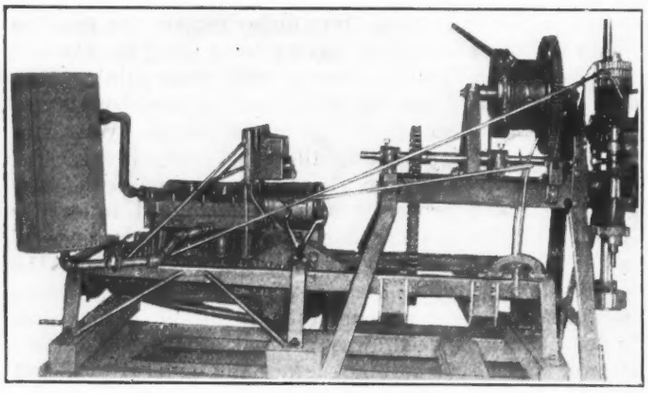
Many leases are being taken in the old Boulder field, which has been making a small production of oil and gas since 1900. Few wells were drilled below 3,000 ft. in this district, none reaching 3,500. The big gasser in the Fort Collins field came in at 4,285 ft.

USEFUL OPERATING IDEAS

Portable Diamond Drilling Outfit

A portable diamond drilling outfit has been devised and used by the International Diamond Drill Contracting Co., of San Francisco. It has proved satisfactory after trial. The unit consists of a Ford automobile chassis and engine mounted on wooden skids. The diamond drill is mounted upon a separate steel frame, as shown in the illustration. A sprocket wheel and chain connects the gear shaft with the driving shaft of the drill.

The rope drum is thrown into and out of action by a pinion. Attached to the skid timbers is a small sheave



Diamond drill outfit using Ford chassis and engine

wheel which guides the rope used to pull the drill into position. This is done by anchoring the free end of the rope to a "deadman" or tree and operating the hoist.

As a result of experience with the unit shown the following improvements were suggested: A swiveled sheave instead of the plain sheave shown; a hoisting drum of greater rope capacity, 250 ft., and an ordinary automobile type of radiator in place of the cooling tank shown in the illustration. The tank type of water container proved unsatisfactory on steep slopes, although it worked satisfactorily after the drill was in position. The foregoing information was obtained through the courtesy of W. J. Mitchell from the International company.

Preventing Skin Infections and Burns from Distillate

Distillate, according to the *Record,* is widely used in the oil fields and in shops for washing the hands and for cleaning tools, pipe, and machinery. Men who frequently use distillate for these purposes often suffer from painful and annoying skin infections and burns. The following suggestions will help prevent these troubles:

Only distillate of good grade, approximately 35 to 40 deg. gravity, should be used.

Thorough washing several times daily with hot water and soap is the best preventive of infections. The pores of the skin tend to become plugged with oil, and infection starts. The only way to stop the infection is to practice cleanliness. Where water is not available wipe the skin dry with clean waste or cotton rags, then wash carefully when work is done.

Adding a small amount of cylinder oil to the distillate will tend to prevent rapid evaporation and chapping of the hands.

Change the clothing at once if it becomes saturated with distillate or gasoline. Never let oil saturated clothing rub against the skin. Never put rags soaked with distillate or gasoline in the pockets of clothing. Change the clothing frequently. Cleanliness is all important.

As soon as an infection starts or a burn develops, consult a doctor. Delay will only make matters worse. An infection may spread rapidly.

Breaking Up Copper Bottoms

BY R. MURRAY-HUGHES

A bugbear to many smelters is the reduction of their furnace copper bottoms to a size suitable for recharging. Chiseling has been a tedious and expensive job, but recently a method was brought to my notice that has proved highly successful. It was devised by a mining man well known in Northern Rhodesia, Ben Mason, and is described as follows:

The bottom is roughly cleaned of adhering matte, slag, and brick, and, whether taken from a circular or rectangular furnace, the shape will be such that a longest axis will become apparent. It is lifted, either by leverage or with jacks, on to two solid blocks (wood, 12x12 in., will do), each of which must be placed as far out towards the end of the axis as the solidity of the mass will allow. Roughly at the center of gravity of the bottom, and normal to the axis, a groove, ¼ in. deep and 2 to 4 in. wide, is chiseled as smooth as possible. All the irregularities of the groove are taken up with a thick paste of clay and water, and as this operation is quite important, considerable care should be given to it. In this partly sealed groove, sticks of gelignite are laid, end to end, from one side to the other; the primer, or detonating cartridge, forms an additional stick and is placed in the center. A heavy cover of the clay paste is now laid over the prepared charge, and the whole is made as airtight as possible preparatory to igniting.

It is quite possible that no effect will be visible after the first charge, but on no account should the bottom be overturned and recharged from the opposite side; the metal has been strained and will usually yield to a second charge placed in the same groove. No disadvantage is experienced by having to use explosive, for the blow is so confined that a ten-stick charge can be safely detonated within 50 ft. of any building.

Use of Mine Rescue Apparatus in Metal Mines

The need for an authoritative statement of the limitations of oxygen rescue apparatus underground in metal mines has long been recognized, but until recently none has been available. In *Technical Paper 334* of the U. S. Bureau of Mines, a committee consisting of D. Harrington, H. J. Rahilly, G. Martinson, O. Woodburn, and H. M. Wolflin presented the following statement (in part abstracted) which is of use as a guide to metal-mine operators:

The equipment required will consist of enough breathing apparatus for two crews of five men each, supplies to maintain the apparatus in use for additional periods of several days, and certain auxiliaries for the use of the crews. Each mine should possess equipment or be allied with some other mine or central station, within an hour's travel, that maintains equipment. The equipment will consist of modern approved two-hour breathing apparatus, an oxygen supply in gaseous, liquid, or chemical form, and regenerators; auxiliaries may consist of half-hour apparatus, portable electric lamps, stretchers, saws, pickaxes, life line, first-aid material, tools for repair of apparatus, portable fans, and other appliances.

Surface Preparations—The mine officials (surface and underground) should be organized for fire fighting and fire prevention. In this organization fire-prevention measures and possible fires should be discussed, with probable action to be taken to prevent spread of fires. The most suitable person or persons to take charge of fire fighting should be agreed upon definitely and desirable fire-prevention and fire-fighting methods and equipment should be planned and provided. At every mine at least five persons (preferably ten or more) trained in the use of oxygen-breathing apparatus should be available. These men should be selected because of their physical and mental fitness, their familiarity with the mine workings, and their reliability in an emergency. The mine officials, if physically capable, should be among those trained in the use of the apparatus, and, at any rate, these officials should be familiar with the use of the apparatus and its limitations.

There should be available and kept up to date and on file at the mine office a list of the things to be done by various persons in case of fire in the mine; also a list with phone and residence addresses of persons to be notified immediately on the outbreak of a fire, this list to include mine officials, state inspectors, safety men, doctors, ambulances, electricians, and officials of intersecting mines. It is also advisable to have on record the mine rescue and similar equipment and the personnel of apparatus wearers of neighboring mines.

At points giving maximum publicity should be posted regulations respecting surface and underground fires, and maps of mine workings should be kept available, these maps showing direction of air currents, location of fans, air splits, doors, water and air lines, hoists, and other machinery, besides indicating, so far as possible, the inaccessible parts of the mine.

One of the most essential devices for the control of mine fires and the protection of apparatus men and other mine-fire workers is a mechanically driven surface fan equipped to permit quick reversal of air currents. Among other equipment that should be available at the surface at time of fire are telephones, portable fans, flexible tubing, fire extinguishers, fire hose and fittings, and a supply of canvas, boards, and nails for bratticing.

Underground Preparations—In addition to being a part of the general fire-fighting organization of the mine as heretofore outlined, underground officials of mines should be able to wear apparatus and should provide such equipment and conditions as will enable apparatus wearers to work in greatest safety and to best advantage. Among the measures that may be taken are: Divide the mine into separate air splits by means of suitable doors and other ventilating devices. Place at each shaft station a suitable list of hoist signals and the designation of that station. Keep suitable exit signs, or signs designating names of drifts, crosscuts, and raises, in good condition. Provide, in so far as may be feasible, that there will be no change of conditions underground while apparatus men are working. Have available, in good condition, a supply of first-aid materials and stretchers as well as men able to give first aid, especially artificial respiration.

Among the methods and equipment suggested for preventing and controlling mine fires are: Guniting; adequate water lines and plenty of hose and accessory equipment; at strategic places fire extinguishers in workeable condition; fire doors in working order; emergency shaft signals and especially signals operable from moving cage; stench warning for miners; telephone system at shaft stations or near mine workings; underground refuge places.

Surface Activities at Time of Disaster—The first duty at the time of a mine fire is to remove underground workers as promptly as possible. Next in importance is the immediate notification of interested persons and organizations, including company officials, state inspectors, apparatus wearers, safety engineers, doctors, ambulances, and adjoining mines—the latter especially if the mines have intersecting workings.

Some one person should take charge of all activities at the mine, and, for a time at least, all matters should be referred to him for decision. Later he should delegate to others certain definite duties, but it is important that one authority should correlate all activities, thus avoiding confusion through conflicting orders and duplication of work.

As soon as possible after a disaster, measures should be taken to exclude from mine workings any and all persons except those authorized to enter for specific purposes. A system of checking all persons into and out of the mine should be established. Mine shafts or entrances and other important places should be roped off.

On the arrival of apparatus wearers, provision should be made to examine them physically to determine their fitness for the work. The testing of apparatus, the assembling of crews, and all matters pertaining to the apparatus should be placed in the control of one man. The best-qualified apparatus man can generally give the best service if he is held to this work instead of being permitted to go underground with crews. There should be no exploration with apparatus until a full crew of five men, thoroughly acquainted with the apparatus, has been assembled, the apparatus thoroughly tested, and, if possible, until each member of the crew has been found to be in proper condition. In general, it is advisable to withhold such explorations until a reserve crew with reserve apparatus is available. As soon as possible a definite place should be designated for storing, assembling, and repairing apparatus. At this place an adequate supply of repair parts, oxygen, and regenerators should be available. After the discovery of fire or a mine explosion steps should be taken to assemble at some convenient point, and to place in good condition, stretchers, blankets, first-aid materials, flash lights and batteries, portable fans, flexible or other air tubing, fire hose, and other necessary apparatus; also to assemble such material as nails, tools, lumber, pipe, and similar articles likely to be needed in restoring ventilation and for bratticing. It would also be advisable to have mice, birds, or mechanical gas detectors, for use in testing air upon entering the mine, and especially in establishing fresh-air bases.

Activities Underground at Time of Disaster—The first duty of underground employees on the discovery of fire is to warn other workers and aid them to escape. As soon as all available men have been removed from the mine immediate measures should be taken to prevent loss of life in fire fighting or recovery work. In making the first exploration with apparatus after a fire, extreme precaution should be taken and progress should be slow. It would be advisable to test the quality of the air, using mice, birds, or possibly a mechanical detector to warn of carbon monoxide gas, and the lamp flame to determine oxygen sufficiency. A fresh-air base should be established when air and other conditions indicate that its establishment will be safe and will facilitate the work. Care should be taken, however, not to have the fresh-air base so close to a fire that non-wearers of apparatus are made ill from small quantities of gas nor to have the base subject to change,

because of a possible outflow of gases cutting off retreat. The base should be supplied with repair and extra parts for apparatus and equipment, and also with first-aid materials. As exploration work progresses, the fresh-air base should be moved forward, but with full precaution taken to protect the retreat of those at the fresh-air base.

Underground Organization of Apparatus Crews—Men of impulsive or excitable nature should not be members of a rescue crew. When the fresh-air base is more than 500 ft. from the mine entrance or shaft landing, the apparatus and portable equipment should be transported by men other than those composing the rescue crew.

Apparatus should be cleaned, repaired, assembled, and tested on the surface, and the apparatus crew should be assembled on and in large measure directed from the surface. At the fresh-air base, the captain of the crew shall be in full command. The reserve crew with apparatus on shall take a position at the fresh-air base.

A written memorandum indicating routes and distances should be made by the captain of the advance crew and left with the captain of the reserve crew. Immediately before leaving the fresh-air base, the apparatus should be thoroughly inspected and any defective condition remedied. The members of a crew should travel together at a slow rate with an interval of two paces between each. In entering a smoky atmosphere and when exploring stopes or workings with many intersections, a crew should use a life line. A code of signaling should be adopted for the control of the crew, and each member should have a signaling device. If, at any time while beyond the fresh-air base, any member of the crew becomes distressed or finds his apparatus working improperly, the entire crew shall return with him to the base. If a crew has to climb ladders, a rope of a length approximating the height of the climb should be provided for use in case one of the crew becomes ill while climbing.

It is dangerous to make an exploration with fewer than five men in a crew. A crew should therefore consist of five men. In general, apparatus crews are expected to search for possible live men and to effect the safe removal of any found. Consequently, the crews have to transport unconscious men in cars, on stretchers, or otherwise through noxious fumes, and it may be advisable to place on these men oxygen apparatus, the half-hour type being applicable for this purpose. Frequently apparatus is used to ascertain the exact location of fires, and then the wearers should not take the risks they might take where life is involved. Similarly, apparatus is employed to construct air locks, build brattices, doors, stoppings and bulkheads, in mine-fire and recovery work, or to restore ventilation.

Maximum Distance Apparatus Wearers Should Travel—When the atmosphere is clear but gaseous and the dip is less than 10 deg., the maximum distance to be traveled by apparatus wearers on unobstructed traveling should be 1,000 ft. on advance and an equal distance in retreat. Where obstructions intervene, the allowable distance may be restricted to a few hundred feet each way, or even less, depending on the dangers due to the obstructions. If water is encountered it is dangerous to go even along a level road where the water is much over one foot deep, for distances of 100 ft. or over.

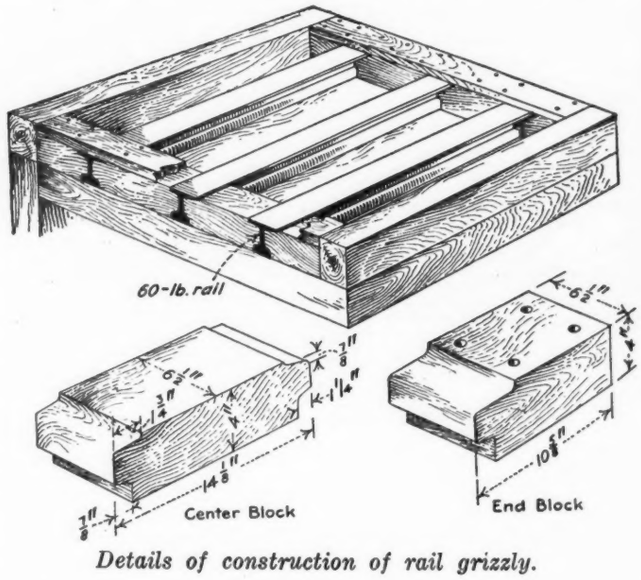
Where the dip is more than 10 deg. and less than about 25 deg., and travel must be undertaken on the floor rather than on ladders or stairways, apparatus trips of over 500 ft. each way are dangerous even in clear cool atmosphere, especially if the floor is smooth. Where obstructions are present, distances even shorter than 500 ft. are dangerous. When the dip is over 25 deg., no apparatus trips should be attempted except on ladders. On inclined ladders (dip up to 60 deg.), where the ladders are in good condition and there are no obstructions, distances up to 200 ft. are permissible in clear air, though if an apparatus wearer becomes helpless his safe removal from 200 ft. of ladderway is difficult. Where obstructions such as close platforms, timbers, or rock falls intervene in ladderways up to 60 deg., even shorter explorations with apparatus should not be attempted. On ladders sloping 60 to 90 deg., explorations with apparatus should not be attempted, even though the circumstances as to clearness of atmosphere, obstructions, and condition of ladders are favorable, except in emergency. In explorations under such emergency, a rope should always be at hand to be used in handling any member of the crew who may become ill or otherwise disabled. Under no circumstances should apparatus wearers climb over 200 ft. of ladder at 60 to 90 deg. and, in general, 100 ft. should be considered the maximum.

In dense smoke, apparatus wearers should travel not more than a few hundred feet, even if no obstructions intervene. To protect each apparatus wearer from falling into holes he should have a cane or staff with which to feel his way. Similarly, travel in dense smoke on a dip over 10 deg., whether on the floor or on a ladder or stairway, obstructed or unobstructed, should be restricted to short distances, preferably under 100 ft. The life line should always be used when exploring in smoky atmosphere. Goggles may be used to advantage in both clear and slightly smoky atmosphere. Several methods are available to prevent fogging.

Types of Apparatus To Be Worn—Recommendations apply to the approved types of two-hour oxygen apparatus. Half-hour apparatus provided with reducing valve or with automatic oxygen feed should be used cautiously and only for very short explorations and by persons familiar with the apparatus. Masks that remove poisonous gases but cannot supply oxygen can probably be used to advantage underground under certain known conditions. However, to introduce them underground is dangerous, because of probability that their use will not be confined to suitable conditions but may be applied to all kinds of disaster work, in which event they will most certainly cause fatalities. The use of these masks underground is not recommended.

Rail Grizzly Construction

A simple rail grizzly for use in stopes at the top of chutes is shown in the accompanying figure. The grizzly bars are lengths of 60-lb. steel rail and are used with the flat side uppermost. Three rails are laid across the top of the chute and are held in their proper positions by wooden blocks which are cut at each end to fit the rail section. The blocks are spiked in position,



Details of construction of rail grizzly.

holes being drilled in the blocks to prevent splitting, and an end board is nailed down over the blocks and rail ends as shown in the accompanying figure. The blocks are 6½x4 in. in section, and are 14⅛ in. long for the center positions and 10⅝ in. for the end positions. The chute shown is 4 ft. 4 in. square and the spacing between the rails is approximately 10 in. The design is in use at the United Verde mine and has been adopted as standard for stope chutes.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Mining Taxation

THE EDITOR:

Sir—We are not aware just what Senator Paul Dupuy has in mind as a proposal upon the subject of taxation, that which you so severely criticise, but for our part we think there is only one just method of taxation and that is to remove all taxes from the "mining industry," according to a phrase which you use, and place them upon the unearned income which is due to increase in mining-site values on account of increase in population and consequent increased need for such sites. This plan would benefit the mining industry, as it would put a restraint upon those holding mining sites out of use for a rise in price which they know must be paid by those who wish to prospect, develop, and operate mining properties.

You speak of "mine owners," but you should distinguish holders of undeveloped properties from the possessors of improved ones, or, in the language of political economy, differentiate land from capital, and advocate the removal of all taxes levied upon capital or the products of labor and place the obligation upon the bandit who holds up the mining industry in the manner described.

Of course, we are aware that these two fellows are sometimes the same gentleman, but that does not alter the ethics of the situation, since in the long run the mining industry as a whole and the people at large will be benefited.

This is not a radical proposal but a rational suggestion, is easily understood and can be practically applied. It will solve the problem of revenue, now so perplexing, in a scientific and utilitarian manner as it will diminish the rewards of idleness and enlarge the returns for thrift and enterprise. JOSEPH MANLET.

Cleveland Heights, Ohio.

Operations at Anyox

THE EDITOR:

Sir—The article which appeared in your issue of Dec. 22 by L. R. Clapp on "Making Copper 600 Miles North of Vancouver" was very interesting, but it gave so few figures that one is unable to compare results with other plants.

As a famous old professor used to say, "Metallurgy is the art of making money out of ores." With the present price of copper, copper metallurgy may become a "lost art."

Converter slag is a big problem in any plant and much more so where the matte is low grade. I have always found that when converter slag was poured into a blast-furnace settler the waste slag ran considerably higher than normal. Does Anyox's analysis (0.01 per cent higher) represent a sample taken across the face of the dump? In my experience with blast-furnace settlers there has always been a layer of clean slag and a layer of clean matte with a layer of "mush" or "foul" slag in between the two. The artificial spinels, magnetite, or other materials formed in the basic converting process are evidently poured into the settlers at Anyox intimately mixed with converter slag. What becomes of them? Unless reduced in some way they must go out in the waste slag. "Spinels" generally carry high values.

If Anyox obtains by differential flotation a concentration of 8 to 1, instead of smelting 3,200 tons of ore per day, there would be only 400 tons of concentrate to smelt. This amount of concentrate could be roasted in four roasters and the calcine smelted in one reverberatory. Such an installation should not be expensive. Much less converting capacity would be required for one reverberatory making a 30 per cent matte as against four blast furnaces making a 15 per cent matte. The converter slag could be poured directly into the reverberatory. The roaster can be used as a combined drier, roaster, and mixer, and thus almost any ore or combinations of ores with sufficient sulphur and iron will be properly prepared for reverberatory smelting. A reverberatory would undoubtedly make an outlet for the increasing tonnages of the greenstone ore.

Washington, D. C. W. B. BOGGS.

Mechanical Mucking

THE EDITOR:

Sir—The article by J. E. Rypinski which appeared in your Dec. 15 issue as a suggestion to aid in mechanical mucking seems to me hardly practical. Such a device as he proposes would, no doubt, save some time in mucking the drift, but would the time so saved offset the time consumed in setting up his contrivance?

He states that the whole structure would have to have the strength of a grizzly in order to withstand the impact of the breaking rock. I imagine it would and also imagine it would have some weight and bulk. Where would it be stored when not in use? How big a crew would it take to assemble it, or would it be in one piece and put in place by means of a traveling crane? How would it be held in place? He certainly would not figure on cutting hitches, yet proper braces would, in the ordinary drift, be in the way of the mucking machine, and thus defeat the purpose for which he intends it.

In a properly drilled round the cut holes only scatter rock. The other holes breaking to the cut leave the rock almost in place. An ordinary pair of trammers will clear the track to the main pile in fifteen minutes or less, and the job may then be finished by machine or hand. Why then the grizzly? H. D. MACDONALD.

Winnipeg, Man.

CONSULTATION

Combining Prospecting and a Mining Education

The following letters testify to the interest shown in a recent communication we published from a subscriber in Idaho and our reply. The first letter is from a professor in a western university:

Under your column headed "Consultation" in the *Journal-Press* of Dec. 29, 1923, you print a letter from a "Daddy" in Idaho who wants to spend his vacations prospecting with his boys. Being a daddy myself of two boys, eight and four years old, to whom I expect to give the same sort of experience in a few years, and likewise having in large part the very information that he lacks, he might be interested in getting in touch with me.

My pet diversion in the interims of teaching mining engineers something of minerals, ores, and rocks is prospecting. I am a trained geologist, but a mining engineer by inclination and experience, and can do anything from framing a square set to frying flapjacks.

Curiously, I have laid definite plans to begin operations in Idaho and expected the past summer to get away and look up a likely prospect or region in which to get some ground, but was prevented by pressure of other work.

If you will kindly send your Idaho correspondent this letter it may open the way to give him the necessary guidance and introduce me to another who has entertained the same ambitions for his boys in disposing of the vacation problem.

The second letter is from A. E. MacArthur, of the Virginia City School of Mines, Virginia City, Nev., and calls attention to the existence of a school for prospectors:

Under the heading of "Consultation" in your issue of Dec. 29 I was very interested in the letter about "daddy and the three boys." Please forward this letter to the writer of the letter:

The Virginia City School of Mines is designed to teach men to become prospectors, miners and millmen. There are no entrance requirements except the ability to speak and read English. There are no tuition charges and no fees. The hours are such that a man may put in sixty-five hours a week. Courses are practical, rather than theoretical. Work covers assaying, chemistry, drawing, mineralogy, blowpiping, geology, mathematics, cyaniding, milling, flotation, methods of mining, timbering and surveying. More detailed information if desired.

Market for a Bismuth Ore

The following inquiry has come from Nevada:

"Can you and will you give me the names and addresses of persons or firms around New York who might be purchasers of a concentrate carrying bismuth, lead, and silver? The bismuth would be in form of oxide. It would be necessary to receive pay for the lead and silver content, as same would be higher than I could throw away."

We do not quite understand why you wish to ship your concentrate all the way to New York, which involves a heavy freight charge. Have you tried the local smelters in Salt Lake City as an outlet for your product? I do not think that there would be any plant in New York City prepared to take your material other than those owned by the large smelting interests, which, of course, have plants also in the West.

The Brinell Scale of Hardness

"Will you kindly give me information regarding the Brinell Scale of Hardness, which I note is referred to in articles appearing in the *Journal-Press* from time to time."

This scale was devised by J. A. Brinell, a Swedish engineer, who in 1900 published a method for determining the relative hardness of steel.

A hardened steel ball ten millimeters in diameter is forced with a pressure of 3,000 kilograms into a flat surface on the specimens or samples of the metal so as to make a slight spherical indentation. The diameter of this indentation may be measured by a microscope or its depth by a micrometer. The hardness is defined as the quotient of the pressure by the area of the indentation. A hardness number is calculated by one of the following formulas from the measurements that are made:

$$H = \frac{K\,(r + \sqrt{r^2 - R^2})}{2\,\pi\,r\,R^2}$$

$$\text{or } H = \frac{K}{2\,\pi\,rd}$$

K = load = 3,000 kg.; r = radius of ball = 5 mm.; R = radius; d = depth of indentation.

The Brinell hardness number is nearly proportional to the ultimate stress determined by tensile tests. It is not, however, a safeguard as to the power to resist abrasion. Tables have been constructed giving the value of R corresponding to various values of H.

Schedule of Premiums Charged by Copper Refineries for Special Shapes

"I wish you would publish in your indispensable journal a table that I have never seen in its pages—the premiums charged by copper refineries for special shapes."

The following table gives the schedule of premiums in effect today for casting special shapes at the copper refineries:

	Per Short Ton
Listed rectangular cakes	
801 to 1,500 lb.	$3.50
1,501 to 3,300 lb.	4.50
3,301 to 4,800 lb.	6.00
Listed bowl-shape cakes	3.00
Listed round cakes	3.00
Listed slabs	1.50
Listed wire bars, 300 to 500 lb.	2.50
Listed wedge bars or cakes	3.50
Ingots	1.00
Billets,	
2½ in.	22.50
3 in.	22.50
4 in.	15.00
5 in.	15.00
6 in.	15.00
7 in.	15.00
8 in.	15.00

Standard shapes for which there is no premium, comprise the following:

Ingot bars, 50 to 70 lb.
Wire bars, 85 to 260 lb.
Square cakes, 14x17, (148 lb.) to 24x24 (800 lb.) 2 in. to 4 in. thick.

Recent Technical Publications

Reviews, Abstracts, and References

How Materials Resist Corrosion

The Chemical Resistance of Engineering Materials. By M. L. Hamlin and F. M. Turner, Jr. The Chemical Catalog Co., New York. Price, $5.

Mining and metallurgical engineers are often confronted with the problem of selecting a material for constructional purposes that will resist acid or alkaline solutions or gases. Information on the chemical resistance of various metals, concrete, wood, asphalt, cotton, and wool, is often hard to find, and sometimes considerable experiment is necessary to find a suitable material. This book is a compilation of the scattered data that have been published, together with some that are new, all well arranged, and presented with critical comments. It should be an extremely valuable aid to all engineers who have problems in the field covered. There is an extensive list of alloys, with their chemical composition, in the appendix. The authors invite contributions from engineers who have carried on private investigations on corrosion, these to be incorporated in the next edition. It is to be hoped that this request will meet with a hearty response, to the end that the book may be made as widely helpful as possible.

Mine Ventilation—"Friction Factors for Fan-piping Used in Mine Ventilation" is the title of U. S. Bureau of Mines *Reports of Investigations* No. 2,540, obtainable on request from the Bureau at Washington, D. C. The report covers work done in co-operation with the Anaconda Copper Mining Co. in one of its Butte mines, which included the use of both galvanized iron and canvas pipes. Recommendations are made as to the proper material to use under various conditions, the proper sizes, and the sizes and kind of blower to give the best results.

Change Houses — Technical Paper 289, 31 pages, illustrated with photographs and drawings, has recently been published by the U. S. Bureau of Mines, Washington, D. C., from which it may be obtained on request. This bulletin is entitled "Change Houses in the Lake Superior Region" and presents the results of a study made by C. E. Kindall. Plans and description of a model change house are offered, and the suggestions may be applied to the construction and operation of sanitary equipment in other regions than Lake Superior.

Destruction of French Mines—We are in receipt of a lecture in French, accompanied by many excellent plates, discussing "The Destruction and the Reconstruction of the Mines of Lens (France)," an English translation being included. We presume that copies can be obtained through A. Bertin, of the Cie. Francaise Thomson-Houston, care International General Electric Co., Schenectady, N. Y.

Treating Complex Ores—U. S. Bureau of Mines *Reports of Investigations* No. 2,544 is an 11-page paper on "Lead-Zinc Separation by Volatilization." The writer, G. L. Oldright, discusses the types of ores most amenable to volatilization, and reviews experimental work carried out at the International smelter at Tooele, at Harbor City, Calif., and on ore from the Simon Silver-Lead and Timber Butte properties. The paper may be obtained from the Bureau, at Washington, D. C., on request.

Ontario Department of Mines—Part X, Vol. XXXI, 1922, of the report of the Ontario Department of Mines, 111 pages, covers mining accidents in Ontario in 1921; gives brief individual reports on all mines and metallurgical works that were in operation in the province during 1922; discusses the formation of instruction classes for prospectors; and includes brief notes on the clays of the Missinaibi River. Copies may be obtained on request from the Department of Mines, Toronto, Ont.

Patents

Electric Smelting Furnace — No. 1,473,784. Nov. 13, 1923. J. C. Dow, Great Falls, Mont. An electric arc furnace with an upright container for ore at one side and one for fuel at the other side. The hot reducing gases arising from the bath of molten material are passed through the mass of solid ore particles, thereby effecting reduction before the mass reaches the molten condition.

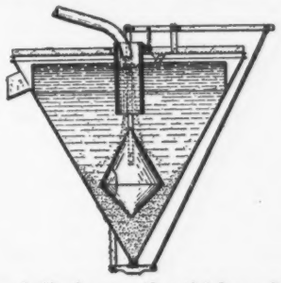
Antimony Recovery—No. 1,475,294. Nov. 27, 1923. Antonin Germot, Asnieres, France. A furnace in which antimony sulphide is heated, out of contact with oxygen, to its dissociation point, the metallic antimony given off being collected by settling.

Magnetic Separators—No. 1,474,624. Nov. 20, 1923. E. W. Davis, Minneapolis, Minn. No. 1,475,394. Nov. 27, 1923. F. A. Jordan, Duluth, Minn. No. 1,475,457. Nov. 27, 1923. W. G. Swart, Babbitt, Minn. These three patents cover devices for separating magnetic from non-magnetic particles.

Tin Refining—No. 1,475,422. Nov. 27, 1923. Georges Bonnard, Plombieres St. Marcel, France. Crude tin is subjected to the action of dry chlorine and the liquid chlorides thus obtained separated from the solid and semi-solid materials. Water is then added to the liquid mixtures to produce a solution of stannic chloride and decompose chlorides of antimony, arsenic, and sulphur. The stannic chloride is then separated and tin produced electrolytically.

Treating Lead Ores—No. 1,475,843. Nov. 27, 1923. H. S. Mackay, London, England. Lead in ore is first converted to lead sulphate and then the ore is leached with a chloride solution. The lead in solution is then continuously precipitated on a metal such as iron. The solution is not allowed to become saturated with lead so that it will lose its efficiency as a solvent, and is used continuously.

Thickener—No. 1,472,317. Oct. 30, 1923. Charles Allen, El Paso, Tex. A cone thickener with a float arranged so as to open a valve at the end of the

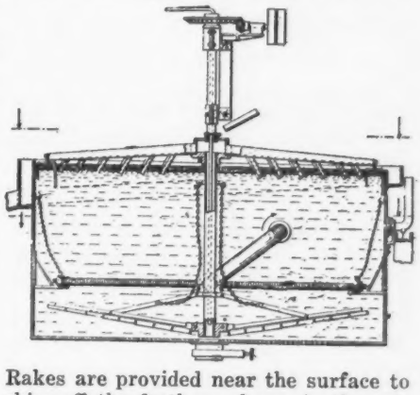


cone and discharge the thickened material when it has reached a certain density.

Volatilizing Process—No. 1,473,722. Nov. 13, 1923. C. S. Fogh, Philadelphia, assignor to Ore Roasting Development Co., Philadelphia. A current of gas is passed in contact with a charge of ore in a roasting furnace, at a temperature sufficient to effect volatilization of valuable metals; the metallic content is then condensed and the gas returned to the circuit to aid in further volatilization.

Patent No. 1,473,723, issued to the same applicant but not assigned, covers a similar process for volatilizing sulphur from sulphur-containing ores. Any dust particles that the gases may contain are removed before the sulphur is condensed. After condensation of the sulphur, the gases are reheated before being returned to the furnace.

Flotation—No. 1,473,160. Nov. 6, 1923. H. R. Robbins, Fierro, N. M. A tank adapted for flotation concentration, having air dischargers placed in a horizontal plane in the pulp but spaced to allow the pulp to pass up and down.



Rakes are provided near the surface to skim off the froth as shown in the cut.

No. 1,473,192 Nov. 6, 1923. Royer Luckenbach, Brooklyn, N. Y., assignor to Luckenbach Processes, Inc., San Francisco. A flotation reagent comprising the reaction product of wood pitch and commercial sulphuric acid, and the acidified reaction product of pitch and caustic soda.

Societies, Addresses and Reports

London World Power Conference to Have U. S. Representation

American Committee Will Have Chance To Tell How Capital Here Has Been Able to Finance Developments

An American committee has been organized to take part in the World Power Conference in London in 1924 at the time of the British Empire Exposition. The committee consists of designated representatives of eight national technical and engineering societies, twelve national business organizations interested in power development, and nine government organizations. To this will be added a group of men prominent in the fields of power development, administration, and finance yet to be selected.

O. C. Merrill is general chairman of the American committee. Among the members of the executive body of this committee are Calvin W. Rice, Peter Junkersfeld, David B. Rushmore, Calvert Townley, and Fred R. Low, president of the A.S.M.E. and editor of *Power*.

This conference, which is being promoted by the British Electrical and Allied Manufacturers' Association, is the first to be held on questions of world power resources and it is expected that reviews of these resources and developments and of the economic and legal problems of the various countries will be presented. The American committee will have a chance to explain to the world the character and extent of American power development from the standpoint of both construction and operation, and will have an opportunity for setting forth the conditions under which American capital has been able to undertake this development and under which it can be expected to aid in the financing of developments in other countries.

Crushed Stone Association Will Meet in St. Louis

Members of the National Crushed Stone Association will hold their seventh annual convention at the Statler Hotel in St. Louis on Jan. 21-24. As is becoming more and more the custom nowadays, an exhibit of model machinery and equipment is to be displayed in connection with the meeting. There will aslo be industrial moving pictures and round-table discussions.

Papers to be presented include one on "Cost Keeping, Labor Handling and Administration of a Moderate-sized Quarry Plant," by R. N. Van Winkle; "Exploration and Geological Examination of a Quarry Property and Their Relation to Financing," by D. B. Rush; and "Market Surveys and Sales Possibilities Analyzed for Financiers," by William C. Huntington. The round-table discussions will include many subjects suggested by practical quarry operators.

M.M.S.A. Holds Annual Meeting in New York

Thomas H. Leggett Elected President, Donald F. Liddell Secretary—Speakers Tell South African Experiences

The annual meeting and dinner of the Mining and Metallurgical Society of America was held Jan. 8 at the Harvard Club in New York. Elections for the year 1924 were announced as follows: President, Thomas H. Leggett; vice-president, B. Britton Gottsberger; secretary and treasurer, D. F. Liddell. Members of the council for districts 1, 2, 3, 4, and 5, J. Parke Channing, Pope Yeatman; for District 8, Richard A. Parker; and for districts 9 and 10, Ira B. Joralemon.

At the dinner, Prof. J. F. Kemp presided as toastmaster. The retiring president, Allen H. Rogers, delivered a presidential address on the engineer as a citizen, pointing out the ways in which the engineer should justify his citizenship. The new president, Mr. Leggett, spoke briefly, touching on the work of the society, and its future. The revision of the mineral law, the work of the committee on foreign and domestic mining policy, and other important investigations of the society were touched upon by both speakers.

Since Mr. Leggett is one of the group of American engineers who spent many years in the South African mines, the other speakers were men of the same group, who had known Mr. Leggett in Africa, and their talks were reminiscences of African days, especially those previous to the Boer War. Fred Hellman and R. C. Catlin discoursed delightfully along these lines.

James Furman Kemp Fund Established

A gift of $20,000 to Columbia University by an anonymous donor is announced by President Nicholas Murray Butler. This sum, it was stipulated, shall be used for the exclusive benefit of the Department of Geology, and shall be known as the James Furman Kemp Fund. The income from the gift of $20,000 may be applied to fellowships, scholarships, loans to students, field research expeditions, office and laboratory researches, purchase of equipment, "or other valid requirements for which there are no stated funds regularly advanced by the university."

A.I.M.E. Indorses Tax Plan

The members of the American Institute of Mining and Metallurgical Engineers are giving unqualified indorsement to the Mellon plan of tax reduction urged upon Congress in the message of President Coolidge. The Institute is the second of the big national engineering organizations formally to go on record in support of the Mellon plan.

Dr. Bain Speaks on Chile Before A.I.M.E.

Few mining engineers have the easy flow of language possessed by Dr. H. Foster Bain, director of the U. S. Bureau of Mines; his talk before the local section of the A.I.M.E. at the Harvard Club on Wednesday, Jan. 2, was therefore particularly easy to listen to. Dr. Bain chose Chile for his subject, he having recently returned from that country after an investigation of the nitrate industry for the government. Most people, he said, do not realize the extent of the country; it has a coastline of about 3,000 miles, equivalent to a strip of land along the west coast of North America from Manzanillo in Mexico to Sitka, Alaska, and about 100 miles wide. Living conditions are difficult in many parts of the country and the death rate is excessive —about 450 per 1,000. Fortunately this is offset by a high birth rate. Dr. Bain gave instances to show how little regard is paid to saving child life.

A marked advance has been made in sanitation since American and English companies have come into the mining fields. Proper food is a problem in many places where the desert land will not produce fresh vegetables, and milk is not procurable.

Chilean labor, on which Dr. Bain dwelt as some length, is usually dependable and efficient. Many of the men are excellent examples of good physique and are adept at hand work, such as shoveling. The price paid for labor is not high, but there is not a sufficient supply. Little can be hoped for from immigration.

Safety Conference Meets on Jan. 22

A joint conference will be held in New York on Jan. 22 at the Engineering Societies Building by the Engineering Section of the National Safety Council and the American Society of Safety Engineers. "Handling Material" and "Welding and Cutting" are the general topics for discussion. An informal dinner will be held in the evening.

Engineering Education Meeting at Ann Arbor Jan. 25-26

The board of investigation and coordination of the Society for the Promotion of Engineering Education will hold a joint meeting with the presidents and deans of engineering schools of the United States on Jan. 25 and 26 at Ann Arbor, Mich. A representative attendance is expected. A program of procedure, which will aim to improve and broaden engineering education, will be discussed. W. E. Wickenden, the newly appointed director of investigations for the society, will be present. Mr. Wickenden, who assumed his new duties Jan. 1, will have his headquarters in New York City. Dean Cooley of the University of Michigan and Dr. F. W. McNair, president of the Michigan College of Mines, at Houghton, are members of the board.

MEN YOU SHOULD KNOW ABOUT

J. M. Callow is again in New York.

A. L. Bell left England recently for Mexico.

Reginald Krall has left England for the United States.

Murry Guggenheim sailed on the "Aquitania" last Saturday.

Dr. J. A. L. Henderson, who has been in Canada, has returned to England.

Karl Eilers has returned to New York from a visit in the Middle West.

W. A. Heywood, of England, is now in this country on professional business.

W. Knox Paton is visiting Canada and the United States on professional business.

S. Daddow has returned to England from Panama. He will later go to Australia.

Samuel Newhouse has resigned as president and director or Idaho Gold Corporation.

Eugene B. Braden, vice-president of the Selby Smelting & Lead Co., was in New York this week.

W. J. Hamilton returned to New York this week after a month's stay at his old home in Montreal.

Prof. Stephen Taber is now Acting State Geologist of South Carolina, with headquarters at Columbia.

O. B. Hofstrand, metallurgical engineer, has returned to Salt Lake after a year's stay in New York City.

A. J. McNab has been elected director and vice-president of the Magma Copper Co., succeeding **Frank W. Holmes.**

Roscoe Teats is now acting as general manager of the arsenic plant at the Globe Smelter, at Globeville, near Denver, Colo.

John G. Kirchen, general manager of the Tonopah Extension Mining Co., has returned to Tonopah from a visit to San Francisco.

John Briar, War Minerals Relief Commissioner, is in Denver investigating certain claims which are before him for decision.

W. R. Thomas, manager of the Tough-Oakes mine, at Kirkland, Ontario, has resigned. He is being succeeded by **B. W. MacDougall.**

J. E. Spurr has been named as Arbitrator for the Zinc Industry by the Zinc Institute, co-operating with the Arbitration Society of America.

Albert H. Fay, of Washington, D. C., has just returned from the Mid-continent oil fields, where he made detailed examinations of a number of properties.

W. B. Cullison has resigned his position on the chemical staff of the Bureau of Mines to accept a place with the Greasoe Chemical Co., of Cleveland, Ohio.

N. M. Getchell, general manager of the Betty O'Neal company, operating near Battle Mountain, in Nevada, has returned to the mine from California points.

Dr. C. H. Clapp, formerly Director of the State School of Mines and Metallurgy of Montana, at Butte, Mont., is now president of the University of Montana at Missoula.

Leslie Urquhart has been for some weeks in South Africa, inspecting the Cam & Motor mine, in the Hartly mining district Southern Rhodesia. Persistent reports of a renewal of Mr. Urquhart's Russian concessions so far lack official confirmation, but negotiations are continuing.

Leslie Urquhart

S. J. Crooker, who has been engaged at the semi-commercial helium plant of the Bureau of Mines at Fort Worth, Tex., is conferring with officials of the Bureau in Washington.

Dr. D. C. Bardwell, a Bureau of Mines chemist, has been transferred from the experiment station at Reno to Washington to do special work on radium and rare metals.

R. R. Sayers, chief surgeon of the Bureau of Mines, has returned from a trip around the world, during which he gathered first-hand impressions as to health conditions in mines.

Thomas F. Donnelly, mining engineer, of New York, has just returned from an inspection of the properties of the American Alum Corporation at Alum Mountain, Grant County, N. M.

Edward Mosehauer, sales manager of the Chile Exploration Co. sailed last Saturday for a two or three months' stay in Europe, in connection with the affairs of the Copper Export Association.

D. C. Jackling sailed from New York on Jan. 9 for Chile, where, as an official of the Kennecott Copper Corporation, he will inspect the mine and plants of the Braden Copper Co. He will be gone two months.

Lucien Eaton, of Ishpeming, Mich., who is superintendent of the Ishpeming district mines of the Cleveland-Cliffs Iron Co., on the Marquette iron range, has been spending the holiday season at Cambridge, Mass.

James G. Scrugham, Governor of Nevada, and **Emmet D. Boyle,** his immediate predecessor in that office, are reported to be organizing a company to conduct placer operations at Round Mountain, Nye County, Nev.

H. K. Masters, manager of the metal department of the Wah Chang Trading Corporation, may now be addressed at 50 Church St., New York City, the address of the company having formerly been the Woolworth Building.

L. K. Armstrong, a well-known mining engineer of the State of Washington, has been selected a candidate for the office of trustee of the Spokane Chamber of Commerce. Mr. Armstrong has long been active in civic affairs in Spokane.

Oliver Bowles, superintendent of the Bureau of Mines Experiment Station at New Brunswick, N. J.; **W. H. Coghill,** and **W. M. Weigel** have returned from a field trip in connection with their study of the possibility of applying metalliferous ore-dressing methods to the nonmetallics.

Charles W. Tubby, who for many years has been district manager in charge of sales and engineering for the Worthington Pump & Machinery Corporation at the St. Paul office, and for the last four years at the Seattle office, left the service of the Corporation on Dec. 31. After Feb. 1 he will again be active in similar work in Seattle.

Ralph Baverstock has just made a partial survey of the Soledad mining district, Mojave, Calif., for the Doak-Chambers Co., of Los Angeles, which is considering the operation of an up-to-date custom milling plant. Also inspecting the camp were **J. R. Davis,** of the Round Mountain mine, in Nevada, and **F. Ish,** a well-known Goldfield operator.

OBITUARY

George Brimston, Sheriff of Yukon Territory, died in the Yukon Hospital, at Dawson, on Dec. 26. He was a pioneer of the Klondike gold rush and was the first to discover gold on the noted Sulphur Creek.

Robert L. McGee, one of the well-known "old-time" operators in the Missouri section of the Joplin-Miami field, died at his home at Duenweg, Mo., on Jan. 2. Mr. McGee was a firm believer in small concentrating plants for the Joplin-Miami field, and suited his practice to his theories to such an extent that his mills were locally famous. At one time a few years ago almost any small mill was referred to as a "McGee coffee mill." Mr. McGee, however, made money in mining zinc and lead.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary of the Week

THE Calumet & Arizona Mining Co. is spending $1,000,000 for remodeling its smelter at Douglas, and equipping its Bisbee mines with an efficient pumping plant.

New Mexican mines doubled the output of the major base and precious metals in the state in 1923.

Coeur d'Alene (Idaho) dividends totaled $4,987,752 in 1923, an increase of $2,000,000.

Current yields in Michigan copper mines average higher than for many years.

Three new mills are about ready for operation in the Crestline, Kan., section of the Tri-State zinc field.

The construction of a new smelter is projected for Patagonia, in Arizona.

Work has been started by the Girand interests on the development of the Diamond Creek power project on the Colorado River.

A proposal has been made in connection with the transfer of the Bureau of Mines to the Commerce Department to establish the title "Secretary of Commerce and Mines."

Calumet & Hecla Consolidated plans to cut copper production costs further as a consequence of current construction work.

Cripple Creek Gold Production $4,161,306 for 1923

Sinking Will Be First Work on Stratton Estate—Deeper Work Is Program in All Properties

With a total gold production of $4,161,306 during 1923, which was almost $500,000 more than the preceding year, Cripple Creek, Colo., enters 1924 with a promise of a still greater increase in output during the next twelve months.

The Hutchinson interests, which recently took over the Stratton Estate, announce as initial operation the sinking of the American Eagle shaft 600 ft. deeper, or to a depth of 2,100 ft. Stations are to be cut at intervals of 200 ft. The upper levels will be leased to the capacity of the plant to handle the work.

The Cresson mine during 1923 produced 123,734 tons, with a gross value of $1,883,137, and the net earnings were $648,224. The total cost per dry ton of all production was $4.93 per ton, a 1c. increase over that of 1922. The net profit on all ore shipped was $5.24 per ton. President Carlton in his annual report states that the reserve of broken ore is the largest in several years. It is announced that the Cresson shaft will at once be sunk 700 ft. deeper.

The Tonopah Ajax, which began initial operations last year, in December shipped the largest tonnage since the company acquired the property, a total of 50 cars. The company has been carrying on an extensive plan of development, and is expected to maintain a materially increasing output for some time.

The Portland produced an average of 2,000 tons per month during 1923; 1,000 tons by the company and 1,000 tons by lessees. The Portland mill treated a total of 152,882 tons, with an average value of $3.37 a ton, and a gross value of $515,312, with net revenue from sale of concentrates and bullion of $413,462. Preparations are now being made to sink the main shaft an additional depth of 270 ft.

The greatest prosperity of the history of the district is forecast by officials.

Calumet & Arizona Spends $100,000 on Construction

RECONSTRUCTION at the smelter of the Calumet & Arizona Mining Co. at Douglas, Ariz., is now nearing completion, with the exception of the electric precipitation plant, the material for which has already arrived. The present work will involve a total of more than $500,000, and includes new crushing and sampling facilities as well as the Cottrell installation. This company also has under way the installation of a new pumping plant at the mine at Bisbee that will cost $500,000. It will be the largest pumping plant in the United States that will have a direct lift of 2,200 ft.

Per-Ton Copper Yield Shows Remarkable Gain in Michigan

Work Richer Veins and Do Selective Mining—Decreased Per-Pound Cost of Copper Is Consequence

The low price of copper has brought about a marked change in mining methods in the Michigan district. Close selection is employed underground and only the richest vein areas are being mined for mill and smelter treatment. As a result, all producing mines in the district finished 1923 with the highest yield, per ton of rock milled, in recent years.

Heretofore tonnage generally has been the principal aim, and much relatively poor rock, mixed with the good, was shipped to the stamp mills. In the washing of so much poor rock, metal losses naturally were greater than at present. It also costs as much to transport and treat a ton of poor rock as it does a ton of rock well mineralized with copper, and a considerable saving in these respects has been effected by the method now followed. Such poor rock as may be broken down either is left in the mine for filling purposes or hoisted to surface and placed on the dump.

Increases in refined yield, per ton of rock treated, are as follows:

Calumet & Hecla—29.74 lb. in 1915 to 47.08.

Ahmeek—20.80 in 1918 to 32.98.

Isle Royale—15.90 in 1918 to 26.92.

Quincy—16.1 in 1911 to 22.83.

Copper Range—1.07 in 1912 to 36.33.

Mohawk—14.22 in 1910 to 23.

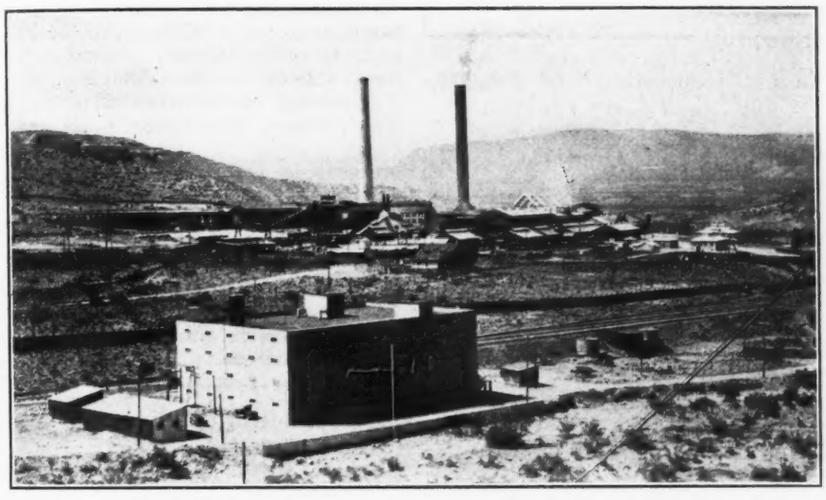
Wolverine—14 in 1915 to 18.

Coeur d'Alene Mine Dividends Totaled $4,987,752 in 1923

Compares With $2,882,750 in 1922—Outlook Good—Hecla Ready to Resume—Callahan Still Idle

Although the Hecla was closed down half the year and the Callahan suspended production on Oct. 1, the record of production and profits made by Coeur d'Alene mines in Idaho during 1923 was far in excess of that of the preceding year. Actual figures are not yet available, but the favorable comparison is indicated by the dividends paid by the chief producing companies. During the year the Bunker Hill & Sullivan disbursed to its stockholders $1,798,750, heading the list. The second place was taken by Hecla, which in spite of the heavy loss by fire and forced suspension for six months, paid $1,150,000 in dividends. This was made possible by the foresight of the management in carrying a "use and occupancy" insurance policy for $1,000,000, which with other insurance and an ample surplus enabled the company to pay regular dividends. Dividends of the Federal Mining & Smelting Co. amounted to $839,032; Hercules estimated, $800,000, and Tamarack, estimated, $400,000. The grand total for 1923 was $4,987,752. For 1922, the total was $2,882,750.

The outlook for 1924 is decidedly bright. Hecla will again be productive on or about Jan. 15. The Hunter is now operating at better than half capacity and will soon have a full force. Several new mines give promise of swelling the output during the new year, and all old producers will be in position to maintain their usual output at least. The high price of lead and the prospect that the demand will continue strong throughout the year is responsible for a general feeling of optimism toward the mining industry in the Coeur d'Alenes. The Callahan Zinc-Lead Co. may resume operations during the summer.



Calumet & Arizona smelter at Douglas, Ariz., where $500,000 is being spent on improvements

Constitution Mill Revamped to Make Lead-Zinc Separation

The Constitution Mining & Milling Co., of the Coeur d'Alene district of Idaho, for the last few months has been engaged in making important changes in its mill on Pine Creek with the view to making a satisfactory separation of its complex lead-zinc ores. This work is now practically completed and test runs are being made, which if satisfactory will result in placing the Constitution among the steady producers. The changes in the mill were made under the personal direction of R. S. Handy, metallurgical engineer and for many years superintendent of mills for the Bunker Hill & Sullivan company at Kellogg. Mr. Handy's connection with the Constitution is in a consulting capacity and he retains his position with the Bunker Hill & Sullivan.

Colorado Tungsten Operations Will Continue Through Winter

The Wolf Tongue Mining Co., operating in the Boulder, Colo., district, shipped $170,000 worth of tungsten concentrate during 1923. The Vasco company shipped approximately 50 tons of a 60 per cent product, valued at about $30,000. The Wolf Tongue company resumed operations in March, 1923, and entered the market as a purchaser of ore at $10 per unit for a 60 per cent product. The company shut down its mill on Nov. 15, and will not resume operations until about April 1. The company anticipates good prices for tungsten during the year.

Ship Lead Ore From Bayard, N. M.

The New Mexico Operation Corporation of New York has just finished the installation of a new 90-hp. steam plant on the Denver lead mine at Bayard, N. M., and is shipping lead carbonate ores. Operations are under the direction of Alford Roos.

Radio Fans Can Soon Operate at Miami, Ariz.

International Smelter Insulates Cottrell Plant—Radio and Electric Precipitation Tend to Mix

The precipitation of flue dust by static electricity makes a great saving at the large smelters, but it also creates much discomfort among the many would-be radio fans of the mining districts within a radius of ten to twenty miles of the installation. Such interference has practically prohibited the use of radio 'phones in the Globe-Miami district, of Arizona, where the Cottrell plant at the International smelter is in operation. Work has now been started insulating the unit in such a manner that the static will be grounded. It is reported that orders were received by the company from the government to take steps to eliminate this disturbance following the receipt of protests from local fans. Heretofore it has been necessary for a few owners of receiving apparatus to go out of the city beyond the limits of the interference for satisfactory receiving. On many occasions, the company has shut down the Cottrell plant for specified times to permit special radio concerts, and it has been understood that the management of the plant was in sympathy with those desiring the interference removed and had stood ready to do so as soon as some scheme could be perfected. Other smelter towns will undoubtedly follow the results of the Miami installation with a view of also making the necessary changes to eliminate the disturbance.

Old Plymouth Consolidated Mine Will Be Developed Actively

The recent London meeting of the shareholders of the Plymouth Consolidated Gold Mines, Ltd., which operates one of the deep Mother Lode mines at Plymouth, Calif., approved plans for the future development of the property. These include the sinking of the main shaft from the 3,400 to the 4,300 level, the initiation of a program of exploration on both the upper and new levels, and the development of the orebodies which have been lately opened up. To provide funds for this work an issue of 240,000 participating preference shares of 5 s. each will be offered early in 1924. These shares, in addition to a fixed 10 per cent preferential dividend, will carry the right to one-half of the surplus profits which may be distributed in each year. Existing shareholders will have the right of allotment of one new preference share for each ordinary share held and may apply for excess shares. The capital of the company will be reduced by writing off 5 s. per share on the ordinary shares.

W. J. Loring, who is manager of the property, recommended a policy of development to the directors. Dr. Maclaren in his report to the company confirmed Mr. Loring's conclusions and the present program was adopted.

Calumet & Helca Sees More Economical Production Ahead

Tamarack No. 5 Pumping Plant, 81st Level Haulageway, and Ahmeek Railroad Among New Projects

Calumet & Hecla Consolidated, in the Michigan copper district, has several important projects under way, all aimed at centralization of operations and at economies. Tamarack No. 5 shaft is being equipped with powerful electrical pumps, which will supersede bailers now in use. The pumps will be capable of lifting water from great depths, and with their installation pumping will be largely concentrated in this shaft, to which the water flowing from the south end of the conglomerate department will be diverted. This arrangement will facilitate the use of the new haulageway at the 81st level of the conglomerate shafts, which will go into operation, it is expected, early the coming summer. The haulage tunnel will be electrically operated, and installation of electrical equipment, tracks, and dumping apparatus is now receiving attention. Rock mined below the 81st level from both the Hecla and Calumet departments will be transported through the haulage tunnel by power locomotives, which will reduce tramming costs, and will be hoisted through the Red Jacket shaft.

Construction work in the new Tamarack reclamation plant, which will reclaim copper from the waste Tamarack conglomerate sand in Torch Lake, is proceeding. Installation of equipment involves the setting up of separators, tables, conveyors, regrinding mills, settling tanks, and flotation and precipitation units. Work on the dredge is well under way and the completion and operation of the entire plant is expected in the spring. Copper will be made for around 6c. per pound, judging from the work done in the C. & H. plant.

The clearing of the right of way for the proposed Ahmeek railroad, work on which has been suspended on account of winter weather conditions, will be resumed as early as possible in the spring. The railroad, between mine and mill, a distance of 9 miles, also will serve other Calumet & Hecla Kearsarge mines, and is designed to effect a considerable saving in transportation costs. At the Calumet & Hecla smelter, a construction program is being put into effect, providing for the installation of a central coal-pulverizing plant and the construction of new furnaces of large capacity.

Apex Standard Resumes Sinking at Eureka, Utah

Shaft sinking is being resumed at the Apex Standard property, in Eureka, Utah. The new shaft is down 110 ft., and will have a depth of 864 ft. Some ore has been opened already on the 900 level, but this was too far from the old shaft for convenient exploitation, and for this reason the new work has been undertaken.

Homestake Produced $6,319,000 in Gold During 1923

THE Homestake mine, at Lead, S. D., the largest gold-producing mine in the United States, continued operations uninterruptedly throughout 1923. Dividends were paid monthly. The Trojan mine was closed in February, 1923, after many years of operation. Placer operations contributed only a small quantity of gold, so that the gold production in South Dakota in 1923, reported by the U. S. Geological Survey as $6,319,000, is virtually all of Homestake production.

Export Association Sold 366,000,000 Lb. of Copper in 1923

Sales by the Copper Export Association during 1923 up to Dec. 17 totaled 366,000,000 lb., at an average of 14.39c. Shipments to foreign countries by the association in 1923 approximated 360,000,000 lb. Of this, 105,302,000 lb., or almost 30 per cent, went to France. England was the next best customer, taking 54,314,000 lb., or 15 per cent. Germany and Holland took 47,480,000 lb.

Sales in the first seventeen days of December totaled 11,250,000 lb., at average price of 13.1c. Of this amount 6,131,000 lb. was sold in the last seven days of the period. This is an average of 662,000 lb. of copper a day. In the first twenty-one days of November the Association sold 51,000,000 lb. of copper, at an average of 12.94c., or about 2,430,000 lb. daily. Sales in December were only little more than 25 per cent of those in November.

Duthie Mines, Ltd., A. S. & R. Subsidiary, Incorporates

Duthie Mines, Ltd., a subsidiary of the Federal Mining & Smelting Co., has been organized with an authorized capital of $1,000,000 and registered offices at Prince Rupert, B. C., to take over and operate the group of properties situated on Hudson Bay Mountain, 13 miles west of Smithers, known as Duthie Mines. Owing to the impassable state of the road between Smithers and the mines, shipping has been suspended, but will be renewed as soon as there is a sufficient bed of snow to make sledding possible. Tractors and sleds will be used in moving ore during the winter.

Keystone Will Increase Shipments When Snow Packs

The Keystone mine, at Park City, Utah, is producing at the rate of 50 tons of ore and concentrates daily. As soon as the snows of the winter season have been packed down so that sleighs may be used, shipments will be considerably increased.

Girand Interests Start Work on Diamond Creek Power Project

Formality to Prevent Lapse of State Franchise — May Hinge on Interstate Treaty on Colorado River

Actual construction has been begun by James B. Girand and associates of the Diamond Creek dam and power project on the Colorado River. This is the first construction to start on the Colorado; the work is the result of the refusal of the state to grant an extension of time on the franchise that was granted a year ago. It is expected that the federal government will secure an injunction or in some manner have the work stopped, due to the fact that the Colorado River state's treaty has not been completed, Arizona being the only state to refuse to sign. The work has been started by the Colorado River Engineering & Development Co., to which Girand has assigned his franchise, in order to have work actually under way before the state-granted franchise expired. Governor Hunt has refused an extension of the permit to Girand, stating that it would be deferred pending a submission of the matter of the treaty to the legislature. The completion of power development on the Colorado means much to the mines of Arizona.

Nevada Hilltop Suspends at Alta Hill Property

Operations have ceased at the Alta Hill shaft of the Grass Valley Gold Mines Co., and a long shutdown is forecast, as the company is in the throes of litigation. Control of the Alta property was acquired by the Nevada Hilltop Co., of Battle Mountain, Nev., during 1923, and exploration continued with no noteworthy results. Other properties have since been acquired by the company in the Grass Valley district, and it is understood that work on these will be continued.

Another capital distribution dividend has been declared by the North Star Mines Co. out of reserve funds. Excellent results have been reported from the development program started about six months ago and the mill is now operating at full capacity. The Neocene Mining Co., operating the Mugwump property, near Alleghany, has struck gravel of good grade.

Hammond Interests Acquire California Placer Ground

The Scales Syndicate, Inc., which is under the control of John Hays Hammond, who is also interested in the La Grange Gold Dredging Co., has acquired large holdings in Sierra County, Calif., at Scales, on the North Yuba River drainage. Preparations are being made to mine the gravel beds on a large scale. Part of the holdings will be hydraulically mined, the debris to be impounded by the Bullard's Bar dam, which was recently completed by the Yuba Power Co.

Hardy Has Gold Prospect

It is reported that Roy A. Hardy, of Virginia City, formerly manager for the United Comstock Mines Co., has exercised his option on mining property in the Buckskin district, 10 miles west from Yerington, Nev. Surface and trench samples indicate that for a distance of 100 ft. along the strike of the vein, for a width of from 2 to 3 ft., the ore will assay $50 per ton in free milling gold.

Heap Leaching Proves Successful at Bisbee and Jerome

The 5,000-ton heap-leaching operation at the United Verde mine at Jerome, Ariz., is proving successful, according to Joseph Irving. The ore is a dense sulphide that runs about 2.5 per cent copper, 36 per cent iron and 40 per cent sulphur. The work seems to prove the efficiency of heap-leaching on two such dissimilar ores as the dense sulphides of the United Verde and the siliceous Copper Queen ores from Sacramento Hill, at Bisbee.

The Copper Queen is preparing a large heap, and has more than 500,000 tons on the ground. The United Verde is now preparing a large heap which will probably run over 1,000,000 tons.

New York Zinc Co. Succeeds Northern Ore Co.

The Northern Ore Co., of Edwards, N. Y., has hold all its mines, concentrating mills, lands, mineral leases, and assets to the New York Zinc Co., Inc. The last-named company is incorporated in New York State with 30,000 shares of stock of no par value. The officers are: T. I. Crane, president; Frank B. Haley, secretary-treasurer, and W. R. Wade, director and manager.

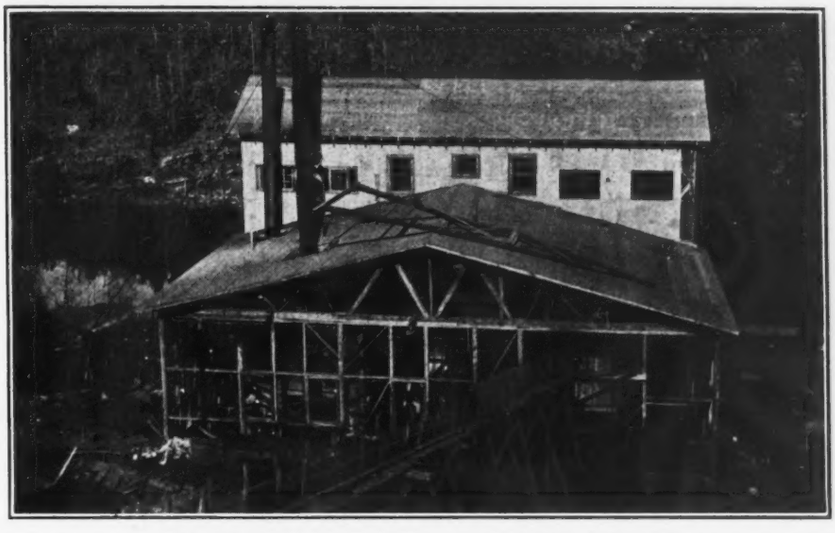
The new company will operate the mines and plants of the Northern Ore Co. and assumes its outstanding contracts and business obligations.

American Manganese Co. Builds Big Concentrator in Arkansas

Plant Handles 600 Tons Per Shift—Steam-Shovel Mining and Joplin Jigs Make 50 per Cent Concentrate—Other Operations

By Tom Shiras
Special Correspondence

THE largest and most modern manganese washing and concentrating plant yet to be built in the Batesville-Cushman manganese field in Arkansas has recently been completed by the American Manganese Co., on its Polk-Southard property. The plant has a capacity of 600 tons per ten-hour shift. The mine at this time is not producing this tonnage, but J. S. Edmundson, superintendent, says that he will be getting capacity in a few weeks.



Modern manganese washer just built in Arkansas

The Polk-Southard mine is a large open pit, the ore running through clay. The material is mined and loaded into automatic dump cars by steam shovel. These cars are handled by a dinky locomotive to a big open-side bin which is 40 ft. long, 16 ft. wide and 16 ft. high; from the bin it is flumed to the mill, a distance of several hundred feet. It is discharged from the flume into a big rotary disintegrator and grizzly combined, where the large stones are removed. The crude is then run over a sizing screen, everything over 2½ in. size going to the picking belt, from which the ore is hand picked, the refuse going into the dump. Material under 2½ in. goes to the two sets of 30-ft. logs, where it is thoroughly washed. From the logs it goes to sizing screens, where it is cut into six sizes: under ¼ in., ½ in., ¾ in., 1 in., 1½ in., and 2 in. Each size goes to a jig, where it is concentrated. These jigs are regular Jopin-type jigs of large capacity, equipped with automatic discharges, from which the concentrates gravitate to the ore bin, the tailing going over the top in the regular way to an elevator, by which it is carried to the dump. The plant is working successfully turning out concentrates that average 50 per cent metallic manganese, with little silica or phosphorus. Mr. Edmundson, who constructed and is operating the plant, comes from Michigan, having been formerly employed in the Lake Superior iron region.

Mining manganese ore by steam shovel in the Batesville-Cushman district

Tom Shell, who is operating a number of manganese properties in the field, has moved his portable washing plant from Club House spring, near Cushman, to his Hawkins mine, 14 miles east of that place. He has enough crude on hand to keep the plant in operation all winter. Stanley Hanford has leased the Club House mine.

New Mexico's Production of Major Metals Doubled in 1923

Chino Busy; Burro Mountain Idle—Gold-Silver Output from Mogollon Increased—Aztec Burned

The metal mines in New Mexico produced $550,000 in gold, 796,000 oz. of silver, 3,900,000 lb. of lead, 67,200,000 lb. of copper, and 16,300,000 lb. of zinc in 1923, having a total gross value of $12,232,000, compared with $412,693 in gold, 752,240 oz. of silver, 3,012,223 lb. of lead, 31,937,207 lb. of copper, and 4,496,806 lb. of zinc in 1922, having a gross value of $5,898,446, according to C. W. Henderson, of the U. S. Geological Survey. The production of each metal thus showed an increase in quantity and an increase in aggregate gross value of more than 100 per cent.

The Chino Copper Co.'s mill at Hurley was operated steadily, treating about 8,000 tons of ore a day. This company produced ore and concentrates containing 56,600,000 lb. of copper, compared with 29,508,582 lb. in 1922. Improvements made in flotation equipment during the last quarter of the year resulted in better recovery. The Burro Mountain Copper mine of the Phelps Dodge Corporation, at Tyrone, was idle all year. The Empire Zinc Co.'s magnetic separation mill at Hanover was operated steadily, the product, a high-grade zinc sulphide, going to the zinc-oxide plant at Canon City, Colo. Lead ores were shipped from Hanover. Lead-zinc sulphide ores were shipped by lessees from the Ozark mine at Kelly. Siliceous ores carrying copper, silver, and gold were shipped from Lordsburg at the rate of 9,000 tons a month. From January to May a large quantity of silver ore was shipped from the Martin dump, at Pinos Altos. Silver ores were shipped also from Silver City. The Mogollon Mines Co., at Mogollon, made an increased output of silver-gold bullion from its cyanidation mill, in which considerable custom ore from the district was treated in addition to company ore. This company has acquired new territory in the district and has done much development work. The Sinaloa company, at Mogollon, was a shipper of silver bullion from January to June, from its cyanidation mill, which was operated on ores from the Deadwood mine.

The Aztec mill, at Baldy, was a steady contributor of gold bullion until May 24, when both the old mill and a new mill were destroyed by fire. The North Homestake amalgamation mill, at White Oaks, was set in operation in 1923 after two years' idleness. Placer gold was produced at Pinos Altos, Golden, and Elizabethtown.

Recently the Chino Copper Co. has curtailed operation at its mine and mill as a measure for economy.

Mill of the Mogollon Mines Co. at Mogollon in New Mexico. The company increased its output of gold-silver bullion in 1923

Seneca Produces Through Gratiot No. 2 Shaft

Gratiot No. 2 shaft, Seneca, in the Michigan copper district, has started production, high-grade rock coming from stopes on the 11th and 13th level south drifts. Development work is proceeding on the 14th, 16th, and 17th levels, south, each of which is disclosing good stamp rock. Sinking and raising are now proceeding in No. 2 shaft, raising having been started from the north terminal of the 3d level drift from Seneca shaft. Seneca shaft continues in splendid ground, with probably the best showing in the 7th or bottom level. Considerable mass copper is coming from this opening. Seneca should be producing at the rate of 1,000,000 lb. of refined copper per month by early spring.

Rich Silver-Lead Ore in Victory Mine

D. C. Simpson has driven into a body of silver-lead ore of shipping grade in the No. 3 adit at the Victory mine, on Hudson Bay Mountain, B. C. This vein has been cut by adits below and above No. 3, where the vein averaged 10 ft. wide and carries a milling ore. The width of the vein in No. 3 adit has not been ascertained by crosscutting, but the full face of the adit is in shipping ore. Mr. Simpson is getting out a shipment, and expects to send a carload of ore to the Selby smelter soon.

Three New Mills in Crestline, Kan., Zinc-Lead Field

Section of Joplin-Miami District Active—Drilling on Leyerle Tract

By Andrew Brothers

The Inter-State Zinc Lead Corporation plans to have two new mines, the Ellis and the Crutchfield, in the Crestline, Kan., section, in operation by the first of February. The shaft at the Ellis is being sunk from the 126-ft. level now, and draining operations are being carried on at the rate of 4,500 gal. a minute, which is pulling the water-level down 6 in. a day.

The Underwriters Land Co. has announced that it will build a mill on the Allie Moore land, just south of the Crutchfield lease. Andrew Brothers, who have been getting good lead production from their property, have taken a lease on the Leyerle land, just north of the Crutchfield, and will drill it. A company has been organized to take over the O. W. Sparks mine, in the same vicinity, and shaft sinking is under way, with the promise, if development operations justify, that a mill will be built in the near future.

American Beauty Ships 50 Per Cent Lead Ore in Nevada

Production has been started at the American Beauty mine, situated 34 miles southeast of Elko, Nev., and the first 50-ton car of ore was shipped early in January. At present the ore is transported from the mine to the truck station by pack animals, and then hauled by auto truck to Elko, a distance of 27 miles. As soon as the snow is deep enough sleds will be used in place of pack animals. Later on an aerial tramway may be installed, depending on the scale of production.

The ore is said to run about 50 per cent lead, and carries from 3 to 5 oz. silver per ton. January production, estimated as from five to six cars, will probably be increased.

Soledad District, in Southern California, Is Busy

Several properties are being actively worked in the Soledad district in Southern California. The United Mines Co. has recently opened two new veins on the west side of Soledad mountain. The company is milling the ore, which contains silver and gold in fair quantity.

The Yellow Dog Extension Mining Co. is operating, as a lease on the Gold Standard, the Russian Boy vein, and has struck the ore in the new shaft.

The Double Standard mine is being sampled with a view to ascertaining what amount of mill ore could be furnished.

The Gold Standard has a crew of men at work developing at the bottom level, now that the crosscut to the Desert mine on the east side of the hill keeps the workings unwatered.

At the Tropico mine, 10 miles south, lessees have found new ore in the lower workings.

High-Grade Silver Strike Empties Keno Hill and Mayo

A RADIOGRAM from Mayo to Dawson City states that phenomenally rich ore, assaying up to 1,100 oz. per ton in silver, has been found at the head of Beaver River, about 50 miles west of Keno Hill, and that a stampede has taken place and the population of Keno Hill and Mayo has been transferred almost entirely to the new district.

Large bodies of galena previously have been found in this district, but the past discoveries always have been too low in silver to make their mining under the difficulties of the district possible. It is feared that the new discovery may have a bad effect on the output of Keno Hill, which, it was expected, would reach 18,000 to 20,000 tons during this winter. The unusually late season already has markedly delayed the beginning of ore shipping to Mayo Landing, though, on the other hand, it has increased the output of gold, as the dredges were operated several weeks later than usual.

Canadian Mineral Production Increased 12 Per Cent in 1923

Preliminary figures of the mineral production of Canada for 1923 show a total value in excess of $214,000,000, an increase of 12 per cent as compared with the previous year. While asbestos and coal established new production records, the biggest increases were in the metallic minerals. The following table shows the comparative value of the chief metallic minerals produced for the two years:

Metal	1922	1923
Arsenic	$321,037	$820,000
Cobalt	1,852,370	2,507,000
Copper	5,738,177	12,515,000
Gold	26,116,050	24,382,000
Lead	5,817,702	7,882,000
Nickel	6,158,993	18,433,000
Silver	12,576,758	10,944,000
Zinc	3,217,536	3,960,000

The decrease in gold is due to the power shortage in northern Ontario, and the production for 1924 should show a substantial increase. Silver production in ounces was greater in 1923 than in 1922, but as the average price per ounce was less, the gross value was smaller.

Texas Helium Plant Succeeds In Semi-Commercial Tests

Bureau of Mines' officials are enthusiastic over the results of the trial runs of their semi-commercial helium plant at Fort Worth, Tex. One of the surprises of the tests was the fact that the plant developed a dependable output at three times its rated capacity. The preliminary runs are regarded as having been completely successful.

News from Washington

By PAUL WOOTON
Special Correspondent

"Secretary of Commerce and Mines" Proposed Designation

Advocated as Step Toward Creation of Department of Mines— Transfer of Bureau of Mines Seems Assured— Oddie Sticks to Bill

AS A STEP toward securing a Department of Mines, a compromise proposal is being considered. It is quite evident that the addition of a Secretary of Mines to the Cabinet can be secured only after a hard fight which, necessarily, must extend over a considerable period. An important step in that direction, however, would be marked by the simple addition of the two words "and Mines" to the "Department of Commerce," making the official designation of that branch of the executive machine read "Department of Commerce and Mines."

The early transfer of the Bureau of Mines to the Department of Commerce seems probable. The President is committed to a policy of strengthening the Bureau of Mines. Arrangements already are being made for increased activities on the part of that Bureau. If, while these changes are being made, the designation of the department can be changed, as mentioned, increased recognition will be given to the mining industry by the Federal Government, and will mark great progress toward a seperate department that will deal with mining matters only.

In the consideration of the legislative step which this will require, it is believed that a way will be found to indicate that, in expanding the Department of Commerce so as to include a major division to handle mining matters, it is the desire of Congress to place at the head of this department a man importantly identified with the mining industry.

The valuable public service which has been contributed by Secretary Hoover, John Hays Hammond, and other mining engineers has impressed Congress with the advantage of having men of that type in the Cabinet. Members of the Senate and of the House of Representatives, with few exceptions, regardless of party, are outspoken in their acknowledgement that Mr. Hoover has done remarkable work as Secretary of Commerce. There is also general recognition on Capitol Hill that one of the two great basic industries is discriminated against when agriculture has a separate department with a budget this year of $70,000,000 and a proposed budget of $85,000,000 for the next fiscal year. For that reason there probably will be little objection to altering the title of the Department of Commerce so as to accord that recognition, at least, to the mining industry. This legislative action, of course, will depend on the transfer of the Bureau of Mines. There is every reason to believe, however, that this will be done, since all that is required is an Executive order. The Secretary of the Interior has formally agreed to the transfer, which would have been made prior to Jan. 1 had it not been for the desire to consult with the joint Congressional committee on reorganization, prior to the making of any transfer under the administration's plan of executive reorganization.

Senator Oddie is determined not to recede from his position. He is not willing to amend his bill, which calls for the creation of a Department of Mines. He expects to make that legislation his chief objective while he remains a member of the United States Senate. Senator Oddie, however, has taken frequent occasion to emphasize that, though he will be entirely satisfied with nothing less than Cabinet recognition for the mining industry, he is ready to help any movement which has as its objective any part of the whole for which he is contending. Some of the advocates of a Department of Mines feel that any compromise might deflect strength from the main objective. Apparently, however, Senator Oddie does not share that view. He feels, it is believed, that the strengthening of the Bureau of Mines, or any other recognition that may come to the mining industry in the meantime, is certain to encourage and to add impetus to the campaign for a mines department.

Fire Destroys $100,000 Woodchuck Mill at Cardin, Okla.

FIRE of unknown origin destroyed the Oklahoma Woodchuck Lead & Zinc Co.'s concentrator near Cardin, Okla., on Jan. 1. The loss is estimated at $100,000, partly covered by insurance. Hard work by the Picher fire department resulted in saving the office building and in preventing spread of the fire to other properties, which was threatened.

The property has been one of the large producers in the field and had just been started up after a week's shutdown for the holidays. About a month ago the company suffered a $5,000 fire loss when its tailing elevator was burned.

Bureau of Mines Will Instruct in Fuel Economy

Object to Conserve Coal and Utilize Fine Anthracite—Cheaper Fuel, Perhaps

In accordance with the President's desire to expand the work of the Bureau of Mines, a plan is being worked out whereby the Bureau will undertake an educational campaign in the matter of increasing efficiency in the use of fuels. The Bureau has been highly successful in its first aid and mine rescue work. It has instructed more than 100,000 miners in the very necessary activities that must be employed in the case of accident. The success of that work demonstrates, it is believed, the feasibility of undertaking instruction in combustion methods which in similar fashion would have to be done by field forces.

Particular attention would be paid under existing conditions to instructing householders in the Northeast and in the Northwest in the burning of substitutes for the stove sizes of anthracite coal. In this way it is believed a real service can be done the anthracite industry, as well as the householders. If the fine sizes of anthracite can be disposed of without loss to the producers, it would make possible reductions in the prices of other sizes.

In the matter of fuel utilization in industrial plants, Bureau of Mines engineers are convinced that proper utilization will reduce the amount of fuel consumed at the average plant by 25 per cent. By the conduct of a campaign in economical fuel consumption recently at brick plants, marked economies in fuel consumption have been made possible. If the same relative saving could be effected at all industrial plants as the result of Bureau activities, price reductions to the public which would mean more to the ultimate consumer than a decided cut in the wages of mine workers would be made possible.

Two Divide Mines Produce—Hasbrouck Starts Shipments

From the Divide district, in Nevada, the Tonopah Divide is shipping about 300 tons of ore per month to the West End mill in Tonopah, and is doing the regular amount of development work, principally on the 1,300 and some of the upper levels. Shipments were cut down in July with the conclusion of the Pittman act purchases.

The Hasbrouck company recently shipped two cars of ore, the first averaging $18 per ton, the second probably higher. Ore is being stoped between the upper and lower tunnel levels, under the old leaser stopes which were worked from the upper tunnel. The oreshoot has been proven for 40 ft. by drifting, and averages 3 ft. wide. Present development consists of drifting and raising from an intermediate level between the upper and lower tunnels. Several good leads have been found.

Brisbane Letter

Special Correspondence
"Engineering and Mining Journal-Press"

Brisbane, Nov. 30.—The extensive and rich lodes recently discovered in the Chillagoe district are pronounced to be clearly occupying an important line of fissuring, and the assay results from outcrop samples are encouraging for the persistence of good silver values at depth. The latest official news from the field shows that on the original lease, the Nightflower, the face in a drift from a shaft put down 28 ft. on the outcrop is disclosing a perfect formation, about 3 ft. of excellent carbonate lying on each side of a sharply defined quartz porphyry matrix, a few inches in width, carrying the lode down with every appearance of permanency. A second shaft, down 15 ft., is also in excellent carbonates, and a third is disclosing rich sulphides. About 100 tons of high-grade ore has already been raised, together with an equal quantity of "second." The lode has been tapped in an adjoining mine, and rich ore is being got from this and several other mines. About half a mile from the Nightflower a second mine has been discovered.

Fluorspar Deposit in Queensland

Fluorspar is common in tin and wolfram lodes in North Queensland, and sometimes occurs as small veins unassociated with other minerals, but large deposits have been unknown. An important lode of this mineral, however, has been opened up 10 miles south of Chillagoe, inland from Cairns. At a shallow depth there has been exposed 2 ft. of clean fluorspar, assaying 97.55 per cent of calcium fluoride and 1.28 per cent of calcium carbonate. A little to the southwestward the mineral outcrops strongly up to 3 ft. in width, occurring apparently in continuous lenses along a practically straight line of fissuring. An average sample from the surface outcrop gave nearly 97 per cent of calcium fluoride; fifteen tons raised from the mine assayed as well.

Small Smelter for Patagonia, Ariz., Is Plan

IT HAS BEEN REPORTED in Arizona, by Fred Kuenzle, a well-known mining man, that a smelter will be constructed at Patagonia. He has gone to Denver, where he says he will purchase smelter equipment. There are many operators in the Patagonia district that are shipping to custom smelters.

Open-cut iron mine at Hibbing, Minn. The Oliver Iron Mining Co. is spending $870,000 for equipment for steam-shovel operations

Oliver Company Will Spend $870,000 for Equipment

Before the shipping season for iron ore on Lake Superior begins next spring, the Oliver Iron Mining Co. plans to purchase equipment of an estimated value of $870,000. Among the important items are the following: Four 50-ton revolving steam shovels for clean-up work, two for the Hibbing district and one each for Virginia and Eveleth; two 40-ton locomotive cranes; twenty-seven caterpillar mountings for steam shovels, four for Virginia, ten for Hibbing, four for Chisholm, six for Canisteo, and three for Eveleth; three electrically operated churn drills; fifteen 30-yard steel dump cars for stripping; and seven steel flat cars each with a capacity of 100 tons.

Another Zinc Smelter Resumes in Wales

Another zinc-smelting works in South Wales has reopened after long idleness, on account of the stronger demand for spelter, chiefly for the increased galvanized sheet trade, says "Commerce Reports." There are large supplies of Australian concentrates on hand. A newly formed company, to be known as the Neath Spelter Co., has taken over the Emu Spelter Works at Neath, and plans to operate on more modern lines to insure the economical treatment of ores. It will employ about 120 men. The industry can be further developed, but skilled labor is scarce.

New Machinery and Inventions

More Powerful Portable Hoist Made in Three Types

One for Slushing, One for General Purposes, and Another for Use Where Large Drum and Rope Capacity Are Needed

ANNOUNCEMENT of a more powerful hoist, with low air consumption, for slushing, hauling, hoisting, and other purposes, has been received with much interest by mines, industrial plants, shipyards, quarries, and other industries where mechanical methods have superseded manual labor for this class of work. This hoist was developed by the Ingersoll-Rand Co. to meet the demand for a more powerful, single drum hoist than other types that have been on the market for several years and have become well known.

Besides having increased power and durability, the new hoist, it is claimed, has a much greater air efficiency than heretofore known in a machine of this type. This low air consumption is due to the fact that the motor runs in one direction only, and has a special design of piston. The air consumption per delivered horsepower varies from 25 to 30 cu.ft. per minute over a range from 5 to 11 hp. at air pressures from 50 to 80 lb. per square inch gage at the throttle.

The new hoist, known as the 10H model of "Little Tugger" hoists, is made in three types, each type being particularly suited for its certain field of operation. The 10H is known as the single drum "slushing" hoist; the 10HB is the "general purpose" hoist, and the 10HL is known as the "large drum" hoist. Though all three types are of the same general construction, minor changes and details have made each the proper machine for its particular field.

The 10H or "slushing" hoist has deep, flared flanges which serve to eliminate rope and drum wear when the rope is not led on straight. The 10HB, or "general purpose" hoist, differs from the 10H only in the provision of a drum with straight flanges and the addition of a brake band and other brake details. Drums and brake details are interchangeable upon both types. This brake-equipped hoist is intended for all industries where material is to be handled.

The 10HL, or "large drum" hoist, differs from the 10HB only in size of drum and base. This hoist is intended for work where a large drum and exceptional rope capacity is needed. This hoist is found especially useful in mines and quarries for the haulage and switching of cars. The drum on this model will accommodate 1,900 ft. of ¾-in. wire cable, compared to 600 ft. on the 10H and the 10HB.

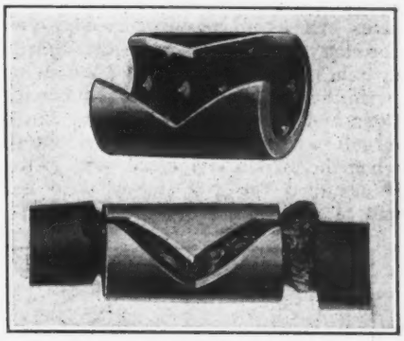
The portability feature has been retained in this more powerful unit. The hoist is small and light enough to be used in small drifts or crosscuts or under very low headings and can be used in several places in the mine during the same shift.

A hoist such as this can be mounted quickly anywhere—clamped to a column or a cross-bar, bolted to a timber, or mounted on a truck. The details of the three types of this hoist are given in the accompanying table.

	10H	10HB	10HL
Weight—less wire rope..	350	365	465
Width.....	14½	18-5/16	32
Length.....	26½	26½	34½
Height.....	18½	18½	24½
Rope Capacity:			
¼ in.....	600	600	1,900
5/16 in.....	375	375	1,300
⅜ in.....	250	250	750

New Wire Splicer Facilitates Use of Portable Tools

Increased use of portable tools has created a demand for a splicer that will be efficient and yet not increase the size of the electric wire at the joint. There has long been need of a splicer that could be applied without solder. The one shown in the cut meets this need. It is one of the new products of the Ohio Brass Co., some of the others being shown also in these pages. The small bronze casting clamps onto the



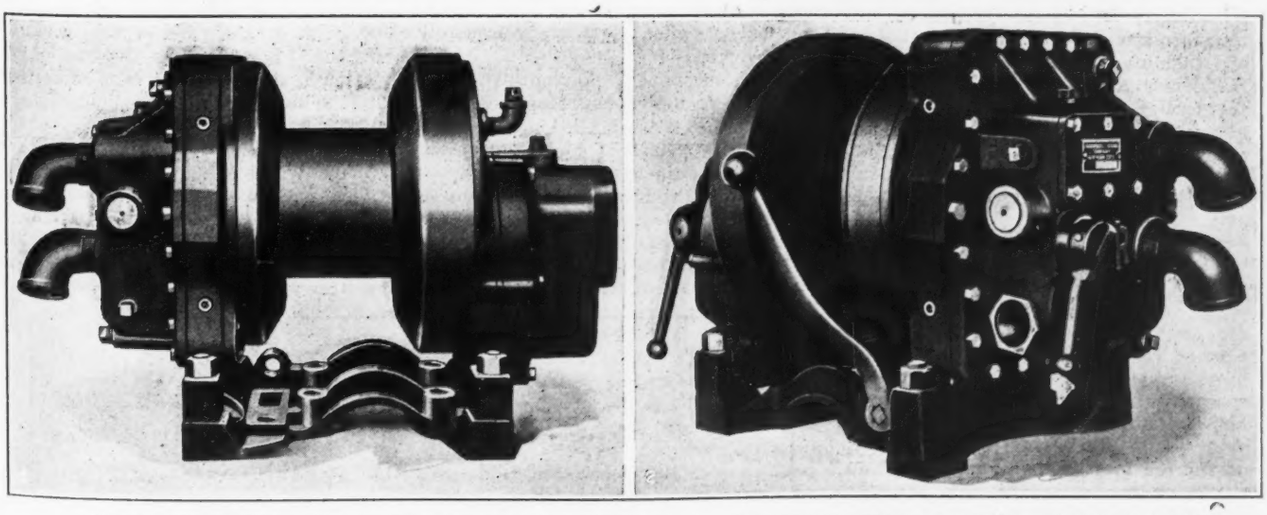
An efficient wire splicer that does not require solder

ends of the cables to be spliced and firmly grips the strands when given a few blows with a hammer. Teeth on the inner surface help to hold the cable tightly and to form a satisfactory joint. When applied the splicer curls up and binds the cable ends firmly together.

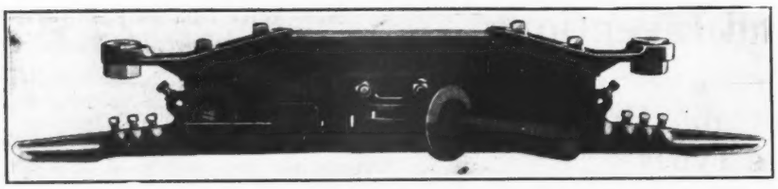
New Section Insulator Switch of Heavy Design

Two features of a new section insulator switch made by the Ohio Brass Co. made it valuable where heavy haulage conditions exist. The design is heavier, affording greater current capacity, ruggedness and mechanical strength. The other feature is the method of suspension which simplifies the problem of roof clearance.

As in other section switches made by the company, there is an underrun for

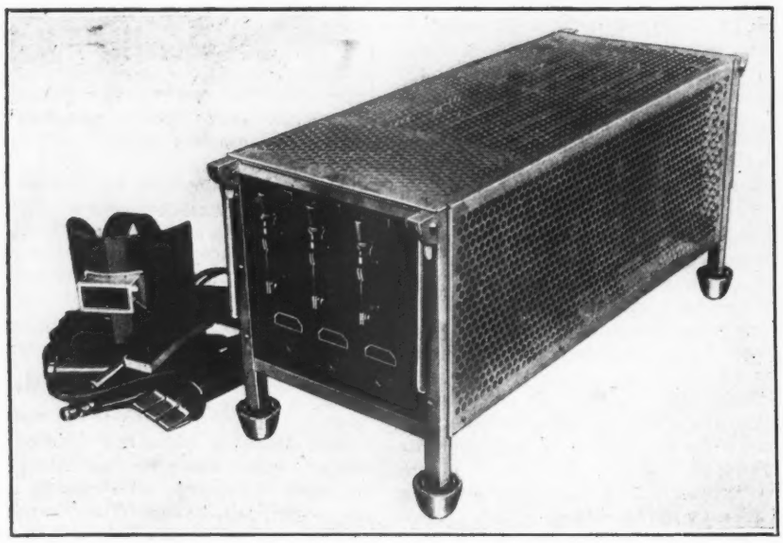


1—Single-drum slushing hoist. 2—This hoist, intended for general purposes, differs from hoist at left in having straight flanges on the drum and a brake



This section insulator switch is designed for carrying heavy currents, even that of the feeder circuit

the trolley wheel even though the switch is open. All parts are made heavy for service with heavy locomotives and heavy motor currents—even for carrying the feeder line through the switch. Lugs on each end of the switch permit installation of feeder connections and allow for opening the feeder circuit as well as the trolley circuit when the switch is opened. The switch is designed for 4-O trolley wire and will take up to a 4-O feeder wire.



Portable resistance arc welder for 400-600-volt direct-current service

The hanger support is below the top of the switch. By setting the suspension brackets to allow this it is possible to keep the trolley height even with one of these switches without cutting into the roof for clearance. Standard insulated hangers should be used. Hangers are installed as they would be for trolley clamps and the switch is attached without further drilling or chipping of the roof.

A Portable Arc Welder for Mine Work

The Ohio Brass Co. has recently developed a new light-weight resistance arc welder for 500-600-volt direct-current service. This is really an enlarged model, slightly modified, of the company's 250-volt machine. It is portable and, without accessories, weighs only 170 lb., these features making it useful for many jobs around a plant.

Plug connections are used on the ebony-asbestos panel board for trolley cable and welding connections. A magnetically operated switch within the frame is connected to make contact when the electrode touches the work. As the arc breaks it opens. A push-button snap switch adjacent to the electrode handle is provided for completely de-energizing the magnetic switch-closing coil, thus making the electrode absolutely dead. Electrodes may be safely handled or replaced when the snap switch is open. The magnetic switch is connected into the line on the trolley side, so that when it is open all parts of the machine are dead except for the one connection from the trolley plug socket to the top of the switch. Thus, the operator is not required to operate any knife switches on the 500-volt circuit except when they are completely de-energized.

The frame is of a substantial welded construction and gives ample ventilation for the resistance elements. The resistance consists of nickel-chromium wire rigidly supported in special refractory cement, and will not sag. These elements are so joined that with the three selective single-pole knife switches and two welding cable connections, fourteen values of welding current are available—from 30 to 210 amperes. The resistance units are insulated from the frame with mica tubes and washers.

This welder will operate efficiently on voltages as low as 400. Regular accessories are provided with the machine. A slow burning fuse is furnished in the trolley contactor.

New Trolley Clamp Easily Installed

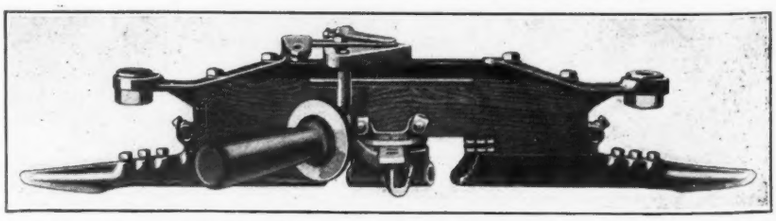
A new trolley clamp of great holding power has also been developed by the Ohio Brass Co., the outstanding feature of which is the automatic operation of the jaws in opening when the nut is turned to the left. The nut can be set to open and hold the jaws ready for receiving the particular size wire to be used. This relieves the man making the installation of the difficult task of lifting the wire into place, using the wrench and keeping the jaws apart—all at the same time.

This bulldog clamp is of simple design, consisting of a nut, stud, two jaws, and a hinge pin of steel of high tensile strength. One size of the clamp will take care of all the usual Fig. 8 and grooved wire sizes without changing the drawers. Another size can be had with different shaped jaws to take all ordinary sizes of round wire.

Section Insulator Switch Has Added Safety Feature

Another new product of the Ohio Brass Co. is a locking-type section insulator switch. This new switch has a knife switch blade and contact clip on the top which are engaged when the switch proper is opened. A permanent grounding cable can be installed in a lug on the switch, so that, when the trolley circuit is opened, the dead side becomes grounded. The switch may be locked open by means of a padlock, holes for which are provided in the switch clip on top.

As in the later O-B switches, the lock switch is suspended by means of support brackets set at a comparatively low point on the ends of the insulated member. This permits the use of insulated hangers without need of cutting into the roof for clearance. The switch is held in a higher position, so that the general height of the trolley is not affected where a section switch is installed. Setscrews at each end of the switch provide a means for running a feeder line through the switch. Such a feeder line will thus be opened when the trolley circuit is opened.



Grounding the dead side of this section insulator switch makes it impossible to feed power into the section from another point

THE MARKET REPORT

Daily Prices of Metals

Jan.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
3	12.625	46.875	47.375	7.85	7.85@7.90	6.30
4	12.625	46.50	47.00	7.85	7.85@8.00	6.35
5	12.50@12.625	46.50	47.00	7.85	7.85@8.00	6 35
7	12.50@12.625	46.875	47.375	7.90	7.85@8.00	6.375@6.40
8	12.50	47.50	48.00	7.90	7.75@8.00	6.40 @6.45
9	12.375	47.875	48.375	7.85	7.75@8.00	6.425@6.45
Av.	12.542	47.021	47 521	7 867	7.900	6 375

*These prices correspond to the following quotations for copper delivered: Jan. 3d and 4th, 12.875c.; 5th and 7th, 12.75@12.875c.; 8th, 12.75c.; 9th, 12.625c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
3	61½	62¼	67½	238⅝	239⅞	30¾	29⅞	33¼	33⅜
4	61¼	61⅞	67½	236	237¼	30¾	29⅞	33½	33½
7	60⅞	61⅜	67	238	239½	30¾	30	34⅛	33⅞
8	61⅜	62	67	242½	243½	30⅞	30½	34⅜	34
9	60⅞	61½	66½	244¼	245½	30¾	30⅛	34⅜	34

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver		Gold London	Jan.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
3	4.27	64⅜	34 3/16	96s 10d	7	4.30	64⅜	33 11/16	95s 10d
4	4.30	64⅝	33 15/16	96s 2d	8	4.28½	64	33 7/16	96s 5d
5	4.29½	64⅜	34 3/16	.....	6	4.29¾	64¼	33 9/16	96s 0d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Jan. 2, 1924

The new year has started auspiciously for all metals except copper. Sales of tin, lead, and zinc have all been good and prices have advanced moderately. But copper, relatively the cheapest of all, has gone begging, and prices have tapered off further. The general opinion seems to be that the coming year will be at least as good and very possibly better for the metal industries than was 1923.

Copper

Consumers are not thought to have provided themselves with copper very far ahead, but they are showing no great anxiety about the matter. As in the last few weeks, buying has been on an extremely limited scale, with certain interests who are anxious sellers shading prices. The larger producers are, in general, holding above the market, content to await the buying movement which they feel must come within the next month. At the first suggestion of firmness in the copper market, it is altogether likely that orders will come in considerable volume and that a quick rebound in the market will occur; it is, of course, natural that consumers should wish to see the market sag as far as possible before this happens.

Statistics released to producers yesterday were far from encouraging; the increase in stocks was much more than generally expected, and domestic deliveries were but little above a hundred million pounds. The virtual break-up of the Copper Export Association, announced in our news pages last week, was also thought to be a bear argument on copper prices in some quarters, though this would seem to be the wrong position to take, since there will no doubt be less pressure to sell copper on the domestic market now that so many producers and custom smelters have an unrestricted export market.

Producers during the week have generally held at 12⅞@13c. delivered. Most of the business on Thursday, Friday and Saturday was booked at the 12⅞c. level. On Monday a fair tonnage was sold at 12⅞@12¾c. but 12¾c. met feeble response yesterday. Today, at least one interest has canvassed the market widely, and is willing to sell even large tonnages at 12⅝c.; it is even reported that 12½c. could be done.

Export business has been quiet, though a large order was booked for France yesterday, at a price, it is reported, around 12⅝c., c.i.f.

Lead

The official contract price of the American Smelting & Refining Co. continues at 7.75c., New York.

The last week has been the best period in the lead trade for a long time. Many sellers opened their books for February business on a more liberal scale, and there has also been more of a tendency for producers to consider orders for March and April, as they feel that present prices may not be maintained. January lead is as scarce as ever and could hardly be obtained for less than 8¼c., New York. Even 8¼c. was obtained for a small amount for prompt shipment from the West, thus netting the producers about 7.90c., St. Louis. A feature of the market has been the sale of Mexican lead, duty paid, in the domestic market. Even January Mexican lead has been available, the price being 6c. in bond, with free lighterage allowed. With the 2½c. duty, this brings the market to 8½c. for New York delivery. A good tonnage of April Mexican lead has also been sold at approximately the same level. Thus the domestic market can hardly mount above present prices unless London prices advance. There is, however, a good likelihood of this happening if much Mexican lead is diverted to this country, for up to now Europe has had no difficulty in absorbing it.

The market in the Middle West has been steady, with producers generally asking about 7.85c., St. Louis, for January, and 7.90c. for Febrary. A

small amount has been sold at 7.75c. These prices are for consumers; dealers have been unable to buy below 8c.

Production still shows no sign of increasing to any marked extent; in fact one Western producer is having difficulty producing enough to meet his minimum contractural requirements. Among the new production coming in soon is Hecla, but the amount that company will produce in January is insignificant, and even in February it is not expected to get up to the amount turned out before the fire. Consumption of lead shows no tendency to decrease. In some lines, such as tinfoil, there may be a slight tendency for business to fall away with high prices, but in general demand is expected to continue as active as ever. Storage-battery makers, particularly, look for a big spring and summer business.

Zinc

Demand for zinc has been good this week, galvanizing interests buying good tonnages. Brass makers continue out of the market. Prices have firmed up to 6.45c., which is being asked today. The weakly held zinc has been taken off the market, and the larger producers today feel that even 6.45 or 6.50c. is too low with concentrates selling for $43 a ton. Furthermore, London prices are almost on a parity with the domestic market; in fact, parity was reached one day in the week. The export of zinc is therefore imminent should London advance or prices weaken at all here. The higher grades of zinc are not quite so active as usual, but this condition will no doubt be remedied when the brass makers decide that the time to buy copper is propitious; zinc requirements will no doubt be taken care of at the same time. High-grade zinc continues at 8@8¼c. delivered.

Tin

The tin market has a stronger tendency, today's prices being about 48⅜c. for spot Straits, over a cent higher than a week ago. Buying has been fairly active, with prompt supplies well taken up. Forward metal has sold for about ½c. less than spot; some orders for shipments from the Straits were placed today at 47⅞c.

Arrivals of tin, in long tons: Jan. 2d, London, 475; Hamburg, 50; Liverpool, 100; Straits, 130; 5th, China, 60; Straits, 40; 7th, Liverpool, 100.

Foreign Exchange

The foreign exchange market has been decidedly weak recently; this week French francs touched a new low for all time. On Tuesday, Jan. 8, cable quotations on francs were 4.8625c.; lire, 4.315c.; and Canadian dollars, 2½ per cent discount.

Silver

Condition remains unchanged, with India active and China quiet.

Mexican Dollars—Jan. 3d, 49⅛; 4th, 49¼; 5th, 49¼; 7th, 49⅛; 8th, 48⅞; 9th, 49.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27½c. London, £115 per long ton.

Antimony — Chinese and Japanese brands, 10c. W.C.C. brand, 11½@12c. Cookson's "C" grade, 11½@11⅝c. Chinese needle antimony, lump, nominal, 6½@7½c. per lb. Standard powdered needle antimony (200 mesh), 8@9c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 8@8½c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—75@80c. per lb. London, 2s. 6d.

Cobalt—$3 per lb. for spot.

Iridium—$275@$300 per oz.

Nickel—26@30c. per lb. for 99 per cent virgin metal. London, £130 long ton.

Palladium—$83 per oz.

Platinum—$122 per oz. London, £29. Crude platinum, $115 per oz.

Quicksilver — $60 per 75-lb. flask. Quiet. San Francisco wires $59.35. London, £9 15s.

The prices of **Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium,** and **Tungsten** are unchanged from prices given Jan. 5.

Metallic Ores

Chrome—$19.50@$22, depending upon grade and source. Nominal.

Manganese—38@42c. per long ton unit, seaport, plus duty. Nominal.

Molybdenum—80c. per lb. of MoS_2 for 85 per cent concentrates. Nominal.

Tungsten Ore—High-grade wolframite, $9; high-grade scheelite, $9.50@$10 per unit. Ordinary grades, $8.25@$8.50.

Iron Ore, Magnetite, Tantalum, Titanium, Vanadium, and **Zircon Ore** are unchanged from Jan. 5 quotations.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 5—Zinc blende, per ton, high, $44.45; basis 60 per cent zinc, premium, $44; Prime Western, $42.50@$43; fines and slimes, $41@$39; average settling price, all zinc ore, $39.43.

Lead ore, high, $107.35; basis 80 per cent lead, $107.50; average settling price, all lead ore, $104.17 per ton.

Shipments for the week: Blende, 13,466; lead, 3,289 tons. Value, all ores the week, $873,760.

With lead in continued strong demand, and the price level advanced $2.50 per ton, sellers withheld zinc ore from the market until prices of blende were advanced $1.50 to $2 per ton on practically all purchases. Most of the supplies of concentrates in the bins are in strong hands.

Platteville, Wis., Jan. 6—Blende, basis 60 per cent zinc, $44 per ton. Lead, basis 80 per cent lead, $106 per ton. Shipments for the week: Blende, 253 tons; lead, 40 tons. Shipments for the year: Blende, 253; lead, 40 tons. Shipments for the week to separating plants, 243 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $325@$450; No. 2, $200@$250; spinning fibers, $100@$125; magnesia and compressed sheet fibers, $60@$90; shingle stock, $50@$70; paper stock $30@$40; cement stock, $17@$20; floats, $6@$12. All f.o.b. mines, per short ton, Quebec.

Barytes—Crude $8.50 per ton, f.o.b. mines.

Market demand not so good as in November. Some consumers of crude are waiting for larger demand for their products. Outlook is favorable.

Bauxite, Beryl, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Graphite, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc and **Tripoli** are unchanged from the Jan. 5 prices.

Mineral Products

Arsenious Oxide (white arsenic)—13½c. per lb.

Copper Sulphate—4.75 per lb., domestic product.

Potassium Sulphate, Sodium Sulphate and **Sodium Nitrate** are unchanged from the Jan. 5 prices.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, generally obtainable at $109 per gross ton, f.o.b. works. Spiegeleisen, 19@21 per cent, $40; 16@19 per cent, $39.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from the prices published Jan. 5.

Metal Products

Copper—Sheets, 21c. base; wire, 15½c.

Lead Sheets—Cut, 10.50c.; full, 10.25c. per lb.

Nickel Silver—18 per cent Grade A sheets, 28c.

Yellow Metal — Dimension sheets, 18.75c.; rods, 15.75c.

Zinc Sheets—Base price, $9.50 per 100 lb., f.o.b. plant.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the Jan. 5 prices.

The Iron Trade

Pittsburgh, Jan. 8, 1924

There is little disposition to predict heavier steel production in 1924 than in 1923, but the output of this half may possibly exceed the output of the second half of last year.

Pig Iron—The market continues dull, but with prices fairly steady, bessemer at $23, basic at $21 and foundry at $22@$22.50, f.o.b. Valley furnaces.

Connellsville Coke—The market continues dull, with spot prices unchanged at $3.75@$4 for furnace and $5@$5.50 for foundry.

Current Prices of Mine Materials and Supplies

RISE AND FALL OF THE MARKET

Declines—Steel sheets and track supplies lower in St. Louis. Cast iron pipe declined at St. Louis and San Francisco. Hollow tile lower at St. Louis. Rough Douglas fir No. 1 dropped in San Francisco. Drop in pine and fir at Boston and Cincinnati. Portland cement lower in New York. Manila rope lower in Seattle and San Francisco.

Advances—Structural material advanced in Dallas. Lumber advanced in New York. Hemlock and spruce higher in Boston. Manila rope advanced ½c. in New York.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.90@3.00	$4.10	$4.00	$5.00	$4.59
Black No. 28	3.85	4.75	4.85	5.80	5.15
Galvanized No. 28	4.90@5.00	5.75	5.85	6.50	6.15

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$43.00	$43.00	.....	$43.00
Standard openhearth rails	43.00	43.00	$43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$3.00@3.15	$2.75	$3.00	$3.85	$4.85	$3.72
Track bolts	4.00@4.25	3.75@4.50	4.00	4.90	6.20	4.57
Standard section angle bars	2.75	2.75	2.75	3.45	4.00	3.20

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.50	$3.00	$3.64	$4.40	$3.45	$3.30	$3.60
Channel, 3 to 15 in.	2.50	3.00	3.64	4.40	3.45	3.30	3.60
Angles, 3 to 6 in., ¼ in. thick	2.50	3.00	3.64	4.40	3.45	3.30	3.60
Tees, 3 in. and larger	2.50	3.00	3.64	4.40	3.45	3.30	3.60
Plates	2.50	3.00	3.64	4.40	3.45	3.30	3.60

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Hercules red strand, all constructions	20%
Cast steel round strand rope	20%
Galvanized steel rigging and guy rope	7½%
Round strand iron and iron tiller	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%

	New York	Cleveland	Chicago
Drill Rod (from list)	55%	40@55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

	Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
BUTT WELD	½ to 3	62	50½	½ to 1½	30	13
LAP WELD	2½ to 6	59	47½	2½ to 4	29	15

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
2½ to 6 in. lap welded	44%	47%	46%

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
6 in. and over	$62.10@63.60	$59.00	$49.00	$57.20@60.20	$52.00	$57.00

Nuts—	New York	Cleveland	Chicago
Hot pressed, sq., per 100 lb. Off list	$1.00	$3.50	$3.50
Cold punched, sq., per 100 lb. Off list	1.00	3.50	3.50

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.1179	$0.1230	$0.0724	$0.125	$0.08	$0.108	.....
6x12x12	.1769	.1844	.0996	.....	.11	.156	.....
8x12x12	.2211	.2305	.1358	.215	.145	.244	$0.1968

MACHINE BOLTS—	New York	Cleveland	Chicago
½ and 1½x3 in. up to 12 in.	15 %	50—5%	50%

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers in yards at San Francisco. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$37.00	$38.00	$39.00	$42.00
3x6 and 8	37.00	38.00	39.00	42.00
4x4-6 and 8	37.00	38.00	39.00	42.00

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, $5 additional.

	New York 20 Ft. and Under	New York 22-24 Ft.	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x4 to 8x8	$43.00	$44.00	$42.50	$44.50
3x10 to 10x10	48.00	49.00	48.50	50.50
3x12 to 12x12	53.00	54.00	55.50	57.50

Other Cities	8 x 8-In. x 20 Ft. and Under Pine	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under Pine	Fir
Boston	$68.00	$95.00	$63.00	$63.00	$80.00	$110.00
Cincinnati	40.00	74.00	74.00	88.00	44.00	78.00
Denver	.....	40.75	40.75	40.75	.....	41.75
Minneapolis	44.00	44.75	41.50	.....	47.00	45.75
Kansas City	44.75	.....	.....	.....	58.75	.....
Birmingham	30@35	.....	.....	.....	40@45	.....

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$3.00	$3.80	$4.25	$4.55	$3.36	$4.95
Cut	....	4.45	5.25	5.75	3.69	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.60	$2.55@2.65	$2.60@2.70
Chicago, f.o.b.	2.10	2.10	2.05
Cleveland, f.o.b.	2.41	2.41	2.36

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	280-lb. net Common
New York	$18.20	$13.10	$3.75	$3.00@$3.25
San Francisco	22.00	.....	....	(180-lb net) 2.10

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$0.95	$0.93	$0.94	$0.93

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry Current	Dry 1 Yr. Ago	In Oil Current	In Oil 1 Yr. Ago
Red	14.00	13.50	15.50	15.00
White	14.00	13.50	14.00	15.50

HOSE—

Fire — 50-Ft. Lengths
Underwriters' 2½-in. coupled — 51½c per ft.

Air—Best Grade
¾-in., per ft. — 3 ply $0.33 — 4 ply $0.42

Steam—Discounts from List
First grade 40–5% — Second grade 45% — Third grade 50%

RUBBER BELTING—The following discounts from list apply to transmission rubber and duck belting:
Competition 60–5% — Best grade 50–10–5%

LEATHER BELTING—List price, 2c. per sq. in. per ply.

Grade	Discount from list
Medium	40–2½%
Heavy	30–5%

RAWHIDE LACING
For cut, best grade, 45–5%, 2nd grade, 55%.
For laces in sides, best, 41c. per sq.ft.; 2nd, 37c.
Semi-tanned: cut, 45–5%; sides, 41c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ½ in.	$0.90
Rubber sheet	.45
Rubber sheet, wire insertion	.70

MANILA ROPE—Per lb., ¾-in. and larger, 1,200-ft. coils.

Atlanta	$0.25	New Orleans	$0.15½
New York	.17½	Seattle	.18
Chicago	.18	San Francisco	.15

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Minneapolis	.1917	.2123
Denver	2025	.2275
Seattle	.165	.19
Cincinnati	.225	.25
New Orleans	195	.22
San Francisco	.1625	.1925

FLOTATION OILS—All prices are per gal. in carload lots; 50-gal. bbls., gross weight 500 lbs.

Pine oil, steam dist., f.o.b. New York	$0.65
Pine oil, pure, dest. dist. f.o.b. New York	.60
Pine tar oil, ref. f.o.b. New York	.48
Pine tar oil, crude, tank cars f.o.b. Jacksonville, Fla.	.32

CHEMICALS—

Zinc dust, 550 lb. casks, f.o.b. Palmerton, Pa., per lb.	$0.09
Litharge, delivered New York, casks, 500 lb. lots, per 100 lb.	10.65
Sodium cyanide, 220 lb. single case lots, f.o.b. New York, per lb.	.21@.22

Freight Rates on Metals, Ores, and Concentrates

In Carload Lots

Copper Bullion and Refined Copper

From	To	Rate per Ton of 2,000 Lb. All Rail	Via Gulf
El Paso, Tex.	Baltimore, Md.	$11.40	$10.00
Garfield, Utah	Perth Amboy, N. J.	12.50	.....
Garfield, Utah	San Francisco	5.85	.....
Hayden, Ariz.	Perth Amboy, N. J.	*14.50	$12.50
Miami, Ariz.	Perth Amboy, N. J.	*14.50	12.50
Anaconda, Mont.	Perth Amboy, N. J.	12.50	.....
Butte, Mont.	Perth Amboy, N. J.	12.50	.....
Humboldt, Ariz.	Chrome, N. J.	*14.50	12.50
Douglas, Ariz.	Perth Amboy, N. J.	*14.50	12.50
Globe, Ariz.	Perth Amboy, N. J.	*14.50	12.50
Clifton, Ariz.	Perth Amboy, N. J.	*14.50	12.50
Clarkdale, Ariz.	Chrome, N. J.	*14.50	12.50
Copperhill, Tenn.	Laurel Hill, N. Y.	$10.80	.....
Tooele, Utah	Chrome, N. J.	12.50	.....
McGill, Nev.	Baltimore, Md.	15.90	.....
Houghton, Mich.	New York	(a)*11.40	.....
Hancock, Mich.	New York	(a)*11.40	.....
Hubbell, Mich.	New York	(a)*11.40	.....
Dollar Bay, Mich.	New York	(a)*11.40	.....
Tacoma, Wash.	New York Conference rate $6.00 via Canal		
Anaconda, Mont.	Tacoma, Wash.	7.09	.....
Ajo, Ariz.	New York	*14.50	$12.50

(a) Applies Dec. 1 to April 1.

Lead Bullion; (Pig Lead Where Shown)

From	Rates per Ton of 2,000 Lb. To New York	To St. Louis
East St. Louis, Ill.	$7.00	.....
Pueblo, Colo.	14.15	$9.65
Leadville, Colo.	16.50	11.40
East Helena, Mont	16.50	11.40
El Paso, Tex.	*10.00 Via Gulf	
	(c) 14.00 All Rail	(b) 7.76½
Omaha, Neb.	9.60	3.65
Murray, Utah	16.50	11.40
Midvale, Utah	16.50	11.40
Tooele, Utah	16.50	11.40
East Chicago, Ill.	6.40	(a) 2.00
Kellogg, Idaho	16.50	11.40
Carnegie, Pa.	3.80	(a) 5.00
Selby, Calif.	(d) 6.00	.....
Herculaneum, Mo.	(a) 8.80	(a) 1.80
Federal, Ill.	7.00	(a) 1.80
Collinsville, Ill.	7.00	(a) .75½
Granby, Mo.	(a) 10.50	(a) 3.50
Joplin, Mo.	(a) 10.50	(a) 3.50

(a) Pig lead only.
(b) Pig lead only when originating in Mexico.
(c) Shipments of bullion originating in Mexico, $2 per ton less.
(d) Conference rate, via canal.

Slab Zinc

From	Rates per Net Ton to E.St. Louis	New York
Donora, Pa.	(a) $4.60	$3.80
Langeloth, Pa.	(a) 4.60	3.80
Palmerton, Pa.	7.10	3.00
Hillsboro, Ill.	1.40	7.00
Danville, Ill.	2.00	6.40
La Salle, Ill.	2.00	6.70
Springfield, Ill.	3.00	7.00
Cleveland, Ohio	5.80	5.00
Moundsville, W. Va.	4.40	3.80
Van Buren, Ark.	3.80	10.80
Fort Smith, Ark.	3.80	10.80
Bartlesville, Okla.	3.50	10.50
Blackwell, Okla.	3.80	10.80
Henryetta, Okla.	3.80	10.80
Sand Springs, Okla.	3.80	10.80
Cherryvale, Kan.	3.50	10.50
Black Eagle, Mont.	9.40	12.50
Park City, Utah	9.00	12.50

(a) To St. Louis, Mo.

Zinc Ores and Concentrates

To	From	Rate per Net Ton
Bartlesville, Okla.	Altoona, Kan.	$2.10
	Pittsburg, Kan.	1.09
	Galena, Kan.	1.30
	Joplin, Mo.	1.40
	Iola, Kan.	1.09
	Baxter, Kan.	1.40
	Miami, Okla.	1.40
	Quapaw, Okla.	1.40
	Kansas City, Mo.	1.60
Sand Springs, Okla.	Miami, Okla.	2.20
	Quapaw, Okla.	2.20
	Galena, Kan.	1.50
	Joplin, Mo.	1.50
	Iola, Kan.	2.40
Dewar, Okla.	Cave Springs, Mo.	2.00
	Cent City Spur, Mo.	2.00
	Chitwood, Mo.	2.00
Kusa, Okla.	Galena, Kan.	1.50
Henryetta, Okla.	Iola, Kan.	2.40
	La Harpe, Kan.	2.40
La Harpe, Kan.	Mound City, Kan.	.50
	Oswego, Kan.	.50
	Parsons, Kan.	.50
Coffeyville, Kan.	Galena, Kan.	1.10
	Joplin, Mo.	1.22
Bartlesville, Okla. (a)	Baxter, Kan.	1.80
	Miami, Okla.	1.80
	Quapaw, Okla.	1.80

(a) Lead ore and concentrates.

Rates on Ores and Concentrates

From	To	Value of Product $5	$10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate														
Butte, Mont.	Anaconda, Mont.	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	17	.17	.17	.17
Butte, Mont.	Black Eagle, Mont. (a)	....	....	....	....	....	....	....	1.01	....	....	....	....	....	....	....
Great Falls, Mont.	East Helena, Mont.	....	....	1.57	....	1.76	....	1.98	....	2.43	....	....	....	....	....	2.55
Butte, Mont.	East Helena, Mont.	....	....	1.17	....	1.46	....	1.69	....	2.03	....	....	....	....	....	2.14
Paxton, Calif.	Salt Lake Smelters, Utah	....	....	....	....	....	....	....	....	6.30	7.00	7.70	....	8.35	8.60	8.85
Johannesburg, Calif.	Selby, Calif.	....	....	....	2.90	....	3.50	....	4.10	4.70	5.30	5.90	....	6.50	6.80	7.10
Johannesburg, Calif.	Humboldt, Ariz.	....	....	....	3.40	....	4.10	....	4.80	5.50	6.20	6.90	....	7.60	8.00	8.30
Pioche, Nev.	Humboldt, Ariz.	....	4.50(c)	7.74	....	8.55	....	9.36	....	9.99	....	....	11.25	....	....	12.42
Creede, Colo.	Durango, Colo.	....	....	3.25	3.50	3.75	4.00	....	4.25	4.75	5.25	5.75	6.05	....	....	7.10
Ouray, Colo.	Durango, Colo.	....	....	4.30	4.80	....	5.05	....	....	5.90	....	6.30	....	....	....	7.70
Kokomo, Colo.	Durango, Colo.	....	6.00	....	....	6.50	7.20	....	....	....	....	....	....	....	....	....
Telluride, Colo.	Durango, Colo.	....	....	....	....	....	4.30	....	5.00	5.90	6.30	6.30	....	....	....	7.70
Silverton, Colo.	Durango, Colo.	....	....	1.40	1.40	....	....	2.20	....	....	2.30	2.55	....	2.80	....	2.80
Tyrone, N. M.	Douglas, Ariz.	....	....	1.60	1.90	....	2.20	....	2.50	2.80	....	....	3.40	....	....	3.80
Tyrone, N. M.	El Paso, Tex.	....	....	1.60	1.90	....	2.20	....	2.50	2.80	....	....	3.40	....	....	3.80
Lordsburg, N. M.	Douglas, Ariz.	....	1.00	1.30	1.60	....	1.90	....	2.20	2.50	....	....	2.80	....	....	3.40
Lordsburg, N. M.	El Paso, Tex.	....	1.00	1.30	1.60	....	1.90	....	2.20	2.50	....	....	2.80	....	....	3.40
Tombstone, Ariz.	Douglas, Ariz.	....	....	.60	....	.90	....	....	....	1.30	....	....	1.60	....	....	1.90
Tombstone, Ariz.	El Paso, Tex.	....	....	1.90	....	2.50	....	....	....	3.80	....	....	4.40	....	....	4.40
Silver City, N. M.	Douglas, Ariz.	....	....	2.48	....	3.15	....	....	....	3.83	....	....	....	....	....	5.29
Ray Junction, Ariz.	Hayden, Ariz.	....	.10	....	.40	....	.50	....	.80	.90	....	....	1.00	....	....	1.10
Sandon, B. C. / Alamo Concentrator, B. C.	Tadanac, B. C.	1.50	1.60	1.70	1.90	2.00	2.50	....	2.60	2.90	3.40	3.50	....	3.70	3.80	3.90
Rossland, B. C.	Tadanac, B. C.	.90	.90	1.00	1.00	1.10	1.50	....	1.60	1.60	1.60	1.70	....	1.70	1.70	1.70
Rossland, B. C.	Tadanac, B. C.(d)	.30	.30	.30	.30	.50	.70	....	.80	.80	....	....	....	....	....	....
Republic, Wash.	Tadanac, B. C.	....	2.02	2.50	2.66	2.86	3.84	....	3.84	3.84	4.69	4.89	....	5.19	5.39	5.59

(a) Minimum tonnage of 200 tons per day. (b) In open cars, minimum 80,000 lb. (c) Siliceous ore tailing.
(d) Applicable on ore, only when shipped in trainload lots of not less than 10 cars and exclusive of switching charges at Rossland.

Rates on Ores and Concentrates

From	To	Value of Ores and Concentrates $10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate													
Burke, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	....	.68	....	....	....	....	1.02
Burke and Wallace, Idaho	East Helena, Mont.	....	....	....	....	3.00	....	3.25	3.50	3.75	4.00	....	4.25	4.50	4.75
Sagel, Idaho	East Helena, Mont.	....	....	....	3.38	....	3.83	....	4.16	....	....	....	....	....	4.84
Arizona Tunnel, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	....	.35	....	....	....	....	.50
Bayview, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	3.75	....	....	4.37½	....	....	5.12½
Park City, Utah	Salt Lake Smelters	1.00	1.10	1.25	....	1.50	....	1.75	....	2.00	....	....	2.25	....	2.50
Eureka, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	....	2.75	3.00	3.25
Tintic, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	....	2.75	3.00	3.25
St. Johns, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	....	2.75	3.00	3.25
Ophir, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	....	2.75	3.00	3.25
Bingham, Utah	Garfield, Utah	....	.40	....	.75	....	....	....	.95	....	....	1.10	....	....	1.25
Cherry Creek, Nev.	Garfield, Utah (c)	....	....	4.60	....	5.10	....	5.60	6.10	6.60	7.10	....	7.60	8.10	8.60
Cherry Creek, Nev.	Garfield, Utah (b)	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	....	7.40	....	....
Goldfield, Nev.	Salt Lake Smelters	....	....	5.10	....	5.80	....	6.50	7.20	7.90	8.60	....	9.30	10.00	10.70
Battle Mountain, Nev. (a)	Salt Lake Smelters	....	*4.15	3.20	....	3.80	....	4.40	5.00	5.60	6.20	....	6.80	7.40	8.00
Palisade, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.80	....	4.40	5.00	5.60	6.20	....	6.80	7.40	8.00
Mina, Nev. (a)	Salt Lake Smelters	....	....	3.60	....	4.30	....	5.00	5.70	6.40	7.10	....	7.80	8.50	9.20
Lovelock, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	....	7.40	8.10	8.80
Golconda, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	....	7.40	8.10	8.80
Hazen, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	....	7.40	8.10	8.80
Tonopah, Nev.	Salt Lake Smelters	....	*4.15	5.10	....	5.80	....	6.50	7.20	7.90	8.60	....	9.30	10.00	10.70
Rogerson, Idaho	Salt Lake Smelters	3.00	....	3.50	....	4.00	....	4.50	5.00	5.50	6.00	....	6.50	7.00	7.50
Georgetown, Colo.	Leadville, Colo.	....	....	3.50	....	3.75	....	4.00	5.00	5.00	5.80	....	5.80	5.80	5.80
Shirley, Colo.	Leadville, Colo.	....	....	2.25	....	2.25	....	2.25	2.25	4.30	4.30	....	4.30	4.30	4.30

(a) Minimum weight, marked capacity of car used, but not less than 80,000 lb. (b) Minimum weight, 80,000 lb. (c) Minimum weight, 40,000 lb.
* Indicates a change of tariff since last report.

November Movements of Ores and Metals

Imports of ores and metals during November, 1923, with revised comparative figures for November, 1922, as compiled from the returns of the Department of Commerce, were as follows:

Imports of Ores and Metals

In Pounds Unless Otherwise Stated

	November, 1922	November, 1923
Antimony		
Ore	.....	128,931
Metal, matte, and regulus	851,424	986,272
Copper		
Ore	14,348,988	7,456,229
Concentrates	4,820,633	5,226,000
Regulus, coarse metal, and cement copper	548,780	.....
Total	19,718,401	12,682,229
Imported from		
Spain	224,800	1,663,525
Canada	490,356	1,994,624
Mexico	3,110,800	1,658,862
Cuba	3,614,415	5,074,688
Chile	10,600,395	1,287,744
Colombia	161	28,560
Peru	272,081	279,448
Venezuela	544,281	.....
Other countries	861,112	694,778
Unrefined black, blister and converter copper in pigs and bars	47,257,504	44,438,675
Imported from		
Spain	5,212,418	.....
United Kingdom	5,504,551	.....
Canada	2,367,064	3,203,712
Mexico	6,597,485	6,781,241
Chile	6,042,629	9,855,661
Peru	8,645,949	12,011,652
Portuguese Africa	12,575,888	12,017,927
Other countries	311,520	568,482
Refined copper	7,922,212	3,006,859
Old and clippings for remanufacture	498,697	191,771
Composition metal, copper chief value	157,891	.....
Copper manufactures	21,619	8,424
Brass		
Old and clippings for remanufacture	6,899,223	523,522
Manufactures of brass	53,195	102,521
Lead		
Ore and matte	6,801,115	17,457,951
Bullion or base bullion	11,471,616	17,813,966
Pigs, bar, other forms of old	301,158	4,761
Manufactures of lead (except type metal)	20,261	26,328
Manganese ore, long tons	9,967	14,790
Pyrites, long tons	28,841	40,066
Tin		
Tin ore	181	.....
Tin in bars, blocks and pigs	9,224,280	11,336,361
Imported from		
United Kingdom	874,325	984,811
British Straits Settlements	6,193,024	9,386,333
China	694,969	.....
Dutch East Indies	57,177	193,320
Hongkong	1,371,954	615,097
Australia	.....	156,800
Other countries	32,831	.....
Zinc ore (dutiable)	.....	416,463
Zinc in blocks and pigs, (dutiable)	8,818	4,253
Zinc dust (dutiable)	5,313	7,931

Exports of copper, lead, and zinc during November, 1923, with revised comparative figures for November, 1922, as compiled from the returns to the Department of Commerce, were as follows:

Exports of Copper, Lead and Zinc

In Pounds

	November 1922	November, 1923
Copper		
Ores, concentrates, matte, and regulus (copper content)	1,000	.....
Copper and manufactures of (total)	56,820,841	74,381,118
Refined, in ingots and bars	48,564,286	64,806,393
Exported to		
Belgium	5,304,340	4,504,319
France	15,218,368	24,248,659
Germany	9,999,558	6,086,216
Italy	4,470,866	13,601,357
Netherlands	1,255,461	2,914,783
Spain	684,373	560,613
Sweden	1,761,649	1,172,199
United Kingdom	8,383,270	4,465,891
Canada	453,355	1,184,294
China	.....	2,861,030
Japan	.....	111,971
Other countries	1,033,046	3,095,061
Old and scrap	226,263	195,924
Composition metal, copper chief value	4,861	31,869
Pipes and tubes	169,946	187,102
Plates and sheets	574,415	399,703
Wire except insulated	1,555,883	818,497
Lead		
Pigs and Bars		
From domestic ore	94,774	524,509
From foreign ore	6,082,852	9,175,960
Exported to		
France	560,275	1,456,286
Germany	1,456,612	.....
Netherlands	392,162	2,240,600
United Kingdom	2,689,080	3,581,053
Other Europe	493,239	1,785,997
Argentina	112,000	245,961
Brasil	346,084	336,027
Other countries	128,174	54,545
Zinc		
Dross	1,763,592	1,449,747
Spelter		
From domestic ore	1,130,485	8,728,752
From foreign ore	213	3,983,685
Total zinc slabs and blocks	1,130,698	12,712,437
Exported to		
Belgium	784,069	336,088
France	224,000	448,081
United Kingdom	.....	10,588,021
Canada	95,137	50,996
Other countries	27,492	1,289,251
In sheets, strips, etc	630,504	708,114
Zinc dust	274,780	453,195
Other zinc manufacturers	160,365	35,831

Financial Aspect of Prominent Copper Producers

The following data have been prepared by Ward, Gruver & Co. and are of interest in giving comparative figures on twenty-two of the principal copper-producing companies.

	Issued Capital	Par Value, Shares	Market Price, March 1, 1923	Market Price, Dec. 24	Recent Market Price of Entire Company or Property, Including Bonds	Present Annual Dividend per Share (a)	Estimated Present Production per Month, Lb.
Anaconda	$3,000,000 B$174,669,000	$50	$52	$36¾	$299,669,000	$3.00	17,000,000
Chile	$4,391,060 B$35,000,000	25	30	27¼	157,949,600	2.50	19,000,000
Kennecott (b)	$3,871,000 B$15,000,000	No Par	45	33½	146,614,000	3.00	17,000,000
Utah	$1,624,490	10	75	63	103,967,360	4.00	20,000,000
Phelps Dodge	$500,000	100	170	145	72,500,000	4.00	17,000,000
Cerro de Pasco	$1,007,462 B$3,792,000	No Par	49	45¾	51,604,000	4.00	8,000,000
Cal. & Hecla Con.	$2,005,502	25	(c) 25	18⅞	38,194,538	2.00	7,100,000
New Cornelia	$1,800,000 B$2,000,000	5	23	16	32,600,000	none	3,200,000
Inspiration	$1,181,967	20	43	24¼	30,731,142	2.00	8,000,000
United Verde	$300,000	No Par			not available		8,000,000
United Verde Ex	$1,050,000	50c	33	27	28,350,000	4.00	3,250,000
Calumet & Arizona	$642,530	10	65	42⅞	28,271,320	2.00	3,700,000
Nevada Con.	$1,999,457	5	17	11⅜	23,934,840	none	6,000,000
Mother Lode	$2,500,000	No Par	13	8	22,500,000	1.00	3,000,000
Ray Con.	$1,577,179	10	17	11½	18,926,149	none	6,000,000
Miami	$747,114	5	30	21½	16,436,508	2.00	5,000,000
Chino	$900,000	5	31	17¼	15,300,000	none	4,000,000
Magma	$240,000 B$3,600,000	No Par	36	30	11,160,000	none	(d) 1,000,000
Copper Range	$394,373	25	46	23	9,859,325	1.00	2,200,000
Granby (e)	$e344,500 B$3,955,000	100	31	13½	8,778,000	none	2,700,000
Greene Cananea	$500,000	100	32	13½	8,000,000	none	3,200,000
Old Dominion	$350,000	25	31	16	5,600,000	none	2,300,000

($) indicates shares. *B* indicates bonds. (*a*) The annual dividends are based upon the last dividend declaration. (*b*) Kennecott owns 1,242,700 shares (76.5 per cent) of Utah Copper. (*c*) Represents selling price March 1, 1923, based upon shares of old company. (*d*) The new smelter should shortly bring production up to 2,000,000 lb. monthly. (*e*) Includes shares provided for acquisition of over 99 per cent of Allenby Copper Co.

MINING STOCKS

Week Ended January 5, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	...	...	50	June 23, Q	$1.50
Alaska-Br. Col.	N. Y. Curb	...	...	*42	.....	....
Allouez	Boston	...	...	*16	Mar. '19	1.00
Anaconda	New York	38⅜	36⅜	37⅜	De. 15, Ja. 21, Q	0.75
Arcadian Consol.	Boston	...	...	2	.....	....
Ariz. Com'l	Boston	...	...	8⅜	July '23,	0.50
Calaveras	N. Y. Curb	...	...	1⅜	.....	....
Calumet & Arizona	Boston	...	...	43⅜	De. 7, De. 24, Q	0.50
Cal. & Hecla (New)	Boston	...	...	19¾	De. 1, De. 17	0.50
Centennial	Boston	...	...	7	Dec. '18, SA	1.00
Cerro de Pasco	New York	47⅜	45½	46⅜	Oc. 18, No. 1, Q	1.00
Chile Copper	New York	28¼	27⅜	28	De. 1, De. 29, Q	0.62½
Chino	New York	20	17⅜	20	Sept. '20, Q	0.37½
Con. Cop. Min. (New)	N. Y. Curb	1¼	1⅛	2	.....	....
Copper Range	Boston	...	...	25⅜	May '23, Q	1.00
Crystal Copper	Boston Curb	70	71	73	.....	....
Davis-Daly	Boston	...	...	4	Mar. '20, Q	0.25
East Butte	Boston	...	...	4⅛	Dec. '19, A	0.50
First National	Boston Curb	35	28	35	Feb. '19, SA	0.15
Franklin	Boston	...	...	*85	.....	....
Gadsden Copper	Boston Curb	*45	*40	*40	.....	....
Granby Consol.	New York	16⅛	14⅜	15⅞	May '19, Q	1.25
Greene-Cananea	New York	16	14	15⅛	Nov. '20, Q	0.50
Hancock	Boston	...	...	1⅜	.....	....
Howe Sound	N. Y. Curb	2⅛	2⅛	2⅛	Ja. 2, Ja. 15	0.05
Inspiration Consol.	New York	26¼	24⅞	26½	De. 20, Ja. 7, Q	0.50
Iron Cap	Boston Curb	...	...	3⅛	May 23, K	0.15
Isle Royale	Boston	...	...	17	Se. 1, Se. 15,	0.50
Kennecott	New York	35⅜	34	34⅝	De. 7, Ja. 2, Q	0.75
Keweenaw	Boston	...	...	*75	.....	....
Lake Copper	Boston	...	...	1⅛	.....	....
Magma Copper	New York	33⅜	30⅛	33¼	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	1⅜	1⅛	1⅜	.....	....
Mass Consolidated	Boston	...	...	1	Nov. '17, Q	1.00
Miami Copper	New York	22⅛	21⅝	22⅛	No. 1, No. 15, Q	0.50
Michigan	Boston	...	...	1	.....	....
Mohawk	Boston	...	...	*32	Se. 22, Oc. 13,	1.00
Mother Lode Con.	New York	8⅛	7⅞	8	De. 14, De. 31	0.50
Nevada Consol.	New York	13⅛	11⅛	13⅛	Sept. '20, Q	0.25
New Cornelia	Boston	...	...	*16⅛	Au. 3, Au. 20, Q	0.25
New Dominion	N. Y. Curb	2⅛	2⅛	2⅛	.....	....
North Butte	Boston	...	...	2¼	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*78	*72	*75	.....	....
Old Dominion	Boston	...	...	15	Dec. '18, Q	1.00
Osceola	Boston	...	...	31⅛	June '23, Q	1.00
Phelps Dodge	Open Mar.	†145	†135	....	De. 20, Ja. 2 Q	1.00
Quincy	Boston	...	...	22	Mar. '20, Q	1.00
Ray Consolidated	New York	12	11	11⅞	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*22	*12	*22	.....	....
St. Mary's Min. Ld.	Boston	...	...	*32	No. 9, De. 11, K	1.00
Seneca Copper	New York	6⅛	5⅛	6⅛	.....	....
Shannon	Boston	...	...	*40	Nov. '17, Q	0.25
Shattuck Arizona	New York	6⅛	6⅛	6⅛	Jan. '20, Q	0.25
South Lake	Boston	...	...	⅛	.....	....
Superior & Boston	Boston	...	...	*90	.....	....
Tenn. C. & C. cfs.	New York	9⅛	9⅛	9⅛	De. 31, Ja. 15, Q	0.25
Tuolumne	Boston	...	...	*41	May '13,	0.10
United Verde Ex.	N. Y. Curb	28	26⅛	27⅜	Ja. 1, Fe. 1, Q	1.00
Utah Consol.	Boston	...	...	*1	Sept '18,	0.25
Utah Copper	New York	65⅛	64⅛	65⅛	De. 3, De. 15, Q	1.00
Utah Metal & T.	Boston	...	...	*30	Dec. '17,	0.30
Victoria	Boston	...	...	*70	.....	....
Winona	Boston	...	...	*20	.....	....
Wolverine	Boston	...	...	5⅛	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	14¼	13⅛	13⅜	Mar.' 19,	0.50
Internat. Nickel pfd.	New York	...	...	79	Oc. 11, No. 1 Q.	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	3⅛	3	3⅛	.....	....
National Lead	New York	143⅛	140	143⅛	De. 14, De. 31, Q	2.00
National Lead pfd.	New York	...	...	111	No. 23, De. 15	1.75
St. Joseph Lead	New York	22⅛	22⅛	22⅛	De. 9, De. 20	0.50
ZINC						
Am. Z. L. & S.	New York	8⅛	8	8	May '20	1.00
Am. Z. L. & S. pfd.	New York	29⅛	26	29	Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅛	4⅞	5⅛	Mar. '23,	0.50
Butte & Superior	New York	16	14⅞	15⅛	Je. 15, Je. 30, Q	0.50
Callahan Zn-Ld	New York	5⅛	4⅛	5⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	...	...	145	Ja. 31, Fe. 9	2.00
United Zinc	N. Y. Curb	...	...	*25	.....	....
Yellow Pine	Los Angeles	...	...	25	Dec. '20, 23	0.03
SILVER						
Alvarado	N. Y. Curb	...	...	1⅛	.....	....
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*25½	*23	*24	May '20, K	0.03
Candelaria	N. Y. Curb	*3	*2	*2	.....	....
Castle-Trethewey	Toronto	*61½	*61	*61	.....	....
Coniagas	Toronto	...	...	2.35	Oc. 19, No. 1, '23	0.02½
Crown Reserve	Toronto	*75½	*75	*75½	Jan. 17,	0.05
Kerr Lake	N. Y. Curb	2	1⅞	1⅞	Oc. 1, Oc. 15, Q	0.12½
La Rose	Toronto	*25	*21	*22	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*13	*12½	*13	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.26	3.16	3.25	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6	5⅞	6	Ja. 1, Ja. 21, QX	0.30⅜
Ontario Silver	New York	7⅜	7⅛	7⅜	Jan. '19, Q	0.50
Temiskaming	Toronto	*33½	*33	*33	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛	⅛	⅛	.....	....
Alaska Juneau	New York	1⅛	1	1	.....	....
Boundary Red M.	N. Y. Curb	...	...	*12	.....	....
Carson Hill	Boston	...	...	2	.....	....
Cresson Consol. G.	N. Y. Curb	3⅜	3⅜	3⅜	De. 31, Ja. 10, Q	0.10
Dome Mines	New York	20⅜	19¼	20	De. 31, Ja. 2, Q	0.50
Golden Cycle	Colo. Springs	...	...	1.08	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	12.50	12.25	12.45	Ja. 10, Ja. 28, M	0.05
Homestake Mining	New York	56½	55	56	Ja. 19, Ja. 25 M	0.50
Kirkland Lake	Toronto	*17	*16	*16½	.....	....
Lake Shore	Toronto	3.55	3.50	3.50	No. 1, No. 15 '23 Q	0.02
McIntyre-Porcupine	New York	18	17½	18	De. 1, Ja. 2,	0.25
Portland	Colo. Springs	...	...	*52	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1⅛	1⅛	1⅛	.....	....
Tom Reed	Los Angeles	...	...	*55	Dec. '19,	0.02
United Eastern	N. Y. Curb	1.12	*98	1.12	Oc. 8, Oc. 28, Q	0.15
Vipond Cons.	Toronto	*96	*96	*96	.....	....
Wright-Hargreaves	Toronto	3.00	2.85	2.99	Se. 15, Oc. 1, Q	0.02½
Yukon Gold	N. Y. Curb	*75	*75	*75	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	...	...	*14	.....	....
Con. Cortez	N. Y. Curb	*59	*55	*59	.....	....
Con. Virginia	San Francisco	4⅛	3⅛	3⅛	.....	....
Continental Mines	N. Y. Curb	2⅛	1⅞	2	.....	....
Dolores Esperanza	N. Y. Curb	*55	*50	*55	Jy. 1, Jy. 10 Q	0.05
Jib Consol	N. Y. Curb	*25	*25	*25	.....	....
Tonopah Belmont	N. Y. Curb	...	...	*50	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*40	*39	*40	Se. 22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	1 3/16	1⅛	1⅛	De. 11, Ja. 1	0.05
Tonopah Mining	N. Y. Curb	...	...	1⅛	Se. 30, Oc. 1	0.07½
Unity Gold	N. Y. Curb	1 3/16	1	1⅛	.....	....
West End Consol.	N. Y. Curb	*61	*50	*57	Mar. '23, Q	0.05
SILVER-LEAD						
Ahumada	Boston Curb	4⅞	4⅞	4⅞	De. 15, Ja. 2, X	0.10
Bingham Mines	Boston	...	...	16	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	82	75	75	Dec. '20,	0.15
Chief Consol.	Boston Curb	3⅛	3⅛	3⅛	Ja. 11, Fe. 1, Q	0.10
Columbus Rexall	Salt Lake	*30	*24	*25	Aug. '22,	0.03
Consol. M. & S.	Montreal	31⅛	29⅛	31⅛	Oct. '20, Q	0.62½
Erupcion	Boston Curb	2	1⅞	1⅞	De. 15, Ja. 2, X	0.125
Federal M. & S.	New York	...	...	9⅛	Jan., '09,	1.50
Federal M. & S. pfd.	New York	43	41	43	No. 26, De. 15,	1.75
Florence Silver	Spokane	*16	*15½	*16	Apr. '19, Q.X	0.01
Hecla Mining	N. Y. Curb	9⅜	9⅛	9⅜	No. 15, De. 15	0.25
Iron Blossom Con.	N. Y. Curb	*32	*32	*32	Oct. 25, '23,	0.02
Marsh Mines	N. Y. Curb	*14	*14	*14	June '21, I	0.02½
Park City	Salt Lake	4.05	4.00	4.05	Se. 15, Oc. 1 Q	0.12
Park Utah	N. Y. Curb	...	...	4	Ja. 1, Q	0.15
Prince Consol.	Salt Lake	...	...	*75	Nov. '17,	0.02
Silversmith	Spokane	*31	*30	*30	Oc. 1, Oc. 10	0.01
Simon Silver-Lead	N. Y. Curb	*2	*1	*2	.....	....
Snowstorm Silver-L.	N. Y. Curb	...	...	*46	.....	....
Tamarack-Custer	Spokane	1.37½	1.35	1.35	Se. 30, Oc. 1, K	0.02
Tintic Standard	Salt Lake	3.65	3.65	3.65	Ja. 5, X	0.25
Utah-Apex	Boston	...	...	2⅛	June '23, Q, X	0.50
IRON						
Bethlehem Steel	New York	54½	53	53½	De. 1, Ja. 2, Q	1.25
Char. Iron	Detroit	⅜	⅛	⅜	.....	....
Char. Iron pfd.	Detroit	...	...	1⅜	.....	....
Colorado Fuel & Iron	New York	26⅜	24½	24½	No 10, No. 26 Q	2.00
Col. Fuel & Iron pfd.	New York	...	...	102	Feb. '23, Q	2.00
Gt. North'n Iron Ore	New York	29	28⅛	28⅛	De. 10, De. 27	2.00
Inland Steel	N. Y. Curb	...	...	46	No. 15, De. 1Q	0.62½
Mesabi Iron	N. Y. Curb	...	...	5	.....	....
Replogle Steel	New York	12⅛	11	11⅛	.....	....
Republic I. & S.	New York	51⅛	50⅛	51	May '21	1.50
Republic I. S. pfd.	New York	89	88⅛	88⅛	De. 15, Ja. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	61⅞	59	60⅛	Feb. '21,	1.50
Sloss-Shef. S. & I. pfd.	New York	...	...	84	De. 20, Ja. 2 Q	1.75
U. S. Steel	New York	100⅛	98⅛	99⅜	No. 29, De. 29, Q	1.50
U. S. Steel pfd.	New York	119⅛	119	119⅜	No. 4, No. 28, Q	1.75
Virginia I. C. & C.	New York	...	...	53	De. 15, Ja. 2	1.50
Virginia I.C.&C. pfd.	New York	...	...	80	De. 15, Ja. 22	2.50
VANADIUM						
Vanadium Corp.	New York	31	29¼	30⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	...	...	29½	Se. 29, Oc. 15 Q	1.00
Asbestos Corp. pfd.	Montreal	57	57	57	Se. 29, Oc. 15 Q	1.50
SULPHUR						
Freeport Texas	New York	12⅜	11⅛	12⅜	Nov. '19, Q	1.00
Texas Gulf	New York	62⅜	61	62½	De. 1, De. 15 QX	2.00
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	2⅜	2⅜	2⅜	.....	....
MINING, SMELTING AND REFINING						
Amer. Metal	New York	44	42⅛	42⅛	No. 17, De. 1, Q	0.75
Amer. Metal pfd.	New York	108½	108½	108½	No. 19, De 1, Q	1.75
Amer. Sm. & Ref.	New York	60⅛	58⅜	60⅛	Ja. 11, Fe. 1, Q	1.25
Amer. Sm. & Ref. pfd	New York	97½	95⅜	97	Fe. 20, Mh. 1,	1.75
U. S. Sm. R. & M.	New York	21⅛	20⅛	21	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	...	...	38⅛	Ja. 7, Ja. 15 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.